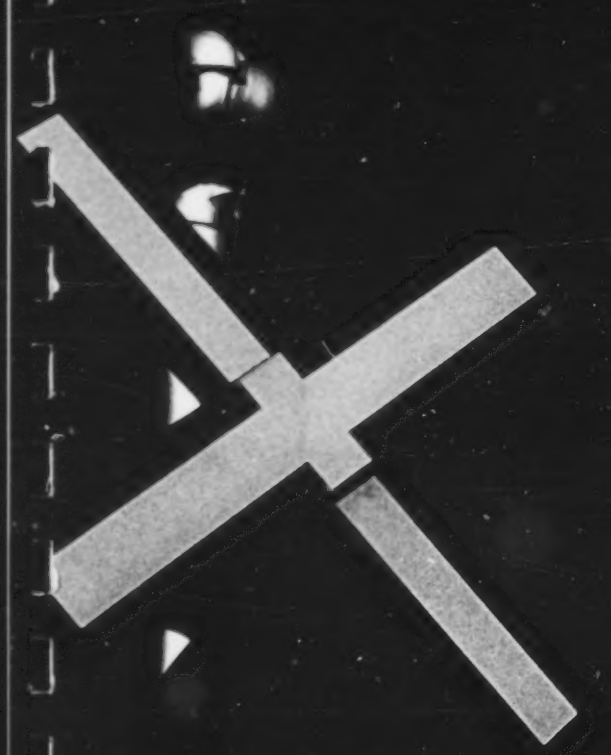
Highway-Railway



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Prepared for
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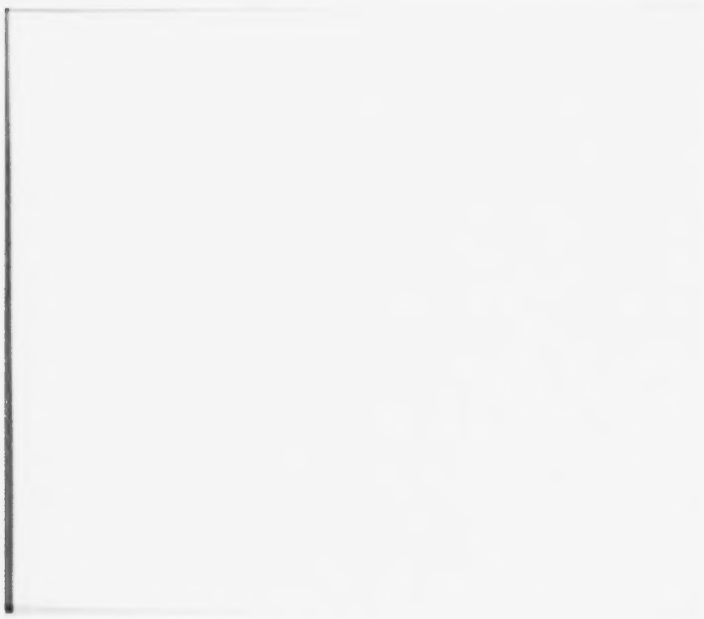

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by

Gordon English and Joseph Murdock

TranSys Research Ltd.
Kingston, Ontario

December 2005

NOTICES

This report reflects the views of the authors and not necessarily those of the Transportation Development Centre of Transport Canada or the co-sponsoring organizations.

Neither the Transportation Development Centre nor the co-sponsoring agenciest endorse products or manufacturers. Trade or manufacturers' names appear in this report only because they are essential to its objectives.

Since some of the accepted measures in the industry are imperial, metric measures are not always used in this report.

Une traduction de ce document est également disponible en français : *Évaluation préliminaire de méthodes automatisées de répression des infractions aux passages à niveau*, TP 14517F.

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16. Abstract

The objective of this study was to demonstrate and evaluate the effectiveness of automated photo enforcement technologies in improving grade crossing safety. The scope of work involved observations of driver behaviour at a pilot installation of automated photo enforcement technology at a non-gated, flashing lights and bells (FLB) grade crossing. Observations were made before and after warning citations were issued for non-stopping violations. It was concluded that automated photo enforcement did reduce risky driver behaviour at the non-gated FLB crossing. It is recommended that both the regulations and automated photo enforcement technology be modified to facilitate the definition and enforcement of unsafe stop-and-go violations at non-gated FLB grade crossings. It is also recommended that the technology's cost effectiveness be assessed and compared with other alternatives.

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16. Résumé

Cette étude avait pour objectif de faire la démonstration de systèmes automatisés de photosurveillance et d'évaluer leur efficacité à améliorer la sécurité aux passages à niveau. Les travaux ont consisté à observer le comportement des conducteurs à un passage à niveau sans barrières muni de feux clignotants et d'une sonnerie (FCS), auquel un dispositif de photosurveillance avait été installé. Les observations ont été faites «avant» et «après» que l'on eut commencé à émettre des avertissements aux conducteurs qui avaient omis de s'arrêter. En conclusion, la photosurveillance s'est révélée efficace à réduire les comportements à risque au passage à niveau FCS sans barrières. Il est recommandé de modifier la réglementation et la technologie de photosurveillance, afin de mieux définir et détecter les infractions du type «arrêt-franchissement imprudent» aux passages à niveau FCS sans barrières. Il est également recommandé d'évaluer le rapport coût-efficacité de la technologie de photosurveillance par rapport à celui d'autres technologies.

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EXECUTIVE SUMMARY

Automated signal enforcement devices have been used widely in Europe for highway traffic violations since the 1970s and in the U.S. and Canada since the 1980s. The application to railway grade crossing is more recent in the U.S. This study was designed to assess the effectiveness of automated photo enforcement at grade crossings in the first pilot test of the technology in Canada.

In prior pilot projects at railway crossings, conventional highway intersection red-light-running technology has been transferred to a grade crossing application without change. This did not pose a problem for those installations, which involved gates or conventional highway signals. Application of the technology at non-gated flashing lights and bells (FLB) crossings introduces additional opportunity to influence safe driver behaviour, but also makes more demands on the wording of the laws that are being enforced and on the technology that is used to enforce the laws.

Due to limitations in the definition of an intersection in the regulations associated with the *Alberta Traffic Safety Act*, tickets could not be issued to drivers during the pilot test. Only warning citations could be issued to owners of vehicles detected violating the laws at the pilot test site. The impact of warning citations was a 53 percent reduction in non-stopping violations, from an average of 8 percent for the prior interval to 4 percent after citations were initiated. Stop-and-go violations were not enforced with the equipment, but this fact was not released in the awareness program. In total, 10 percent of drivers either did not stop or proceeded through the flashing red lights after stopping, but while the train was approaching. The average for the "before" observation interval was 32 percent. Thus the impact of the warnings was a 69 percent reduction in combined violations. In terms of the hazard scale adopted for the evaluation, a reduction of 61 percent in the hazard-index was realized. Thus, we concluded that automated photo enforcement did reduce risky driver behaviour at the non-gated FLB crossing.

There are two types of potential violations at grade crossings equipped with flashing lights and bells: drivers who do not stop when the warning system is activated, and drivers who stop but proceed when it is unsafe to do so. The present technology can detect vehicles that do not stop, but does not provide a means of automatically detecting the second type of risky behaviour. We recommend that both the regulations and automated photo enforcement technology be modified to facilitate the definition and enforcement of unsafe stop-and-go violations if the technology is to be used at non-gated FLB crossings.

Many vehicles are accelerating or decelerating at grade crossings, often as much in response to the bump encountered as from a cautionary move. Consequently, systems that ignore violations by vehicles that are accelerating/decelerating will have a lower enforcement rate. We recommend that road authorities relax the speed accuracy specification for failure to stop violations and that suppliers relax the present software constraints that exclude accelerating/ decelerating vehicles from violation processing.

There were also several unsafe acts and other signs of confusion among drivers during the initial period of hardware installation. The observations accentuate the importance of having laws that place reasonable expectations on drivers and having awareness campaigns that detail the constraints and allowances of the laws (or the common interpretation of the laws) before automated photo enforcement hardware is installed.

The types of risky driver behaviour that were exacerbated by the presence of the automated photo enforcement system and did not involve trains included drivers bypassing stopped vehicle queues and drivers swerving to avoid the detection loops in the highway. Both of these activities could be

mitigated by using loops on both lanes of the highway rather than only on the entrance lanes as was done at RR-232. We recommend that loops be placed on both lanes of the highway in future applications of the technology at non-gated FLB crossings.

Automated photo enforcement can only enforce the existing laws. We believe that traffic laws need to achieve a balance between specifying actions that are recognized as safe, while allowing drivers to make fair and reasonable judgments in response to the wide range of circumstances they can encounter. The present laws and regulations applied at grades crossings vary across Canada and North America. It is our opinion that laws dealing with complex situations should be kept simple and the details of the range of scenarios that can exist should be left to driver education programs. Appropriate driver response to railway crossing signals, while involving a complex set of scenarios requiring driver interpretation and judgment, is the smallest (and in many cases non-existent) component of most driver training manuals. We recommend that Transport Canada encourage provinces to highlight the various situations and complexities that exist at railway grade crossings and develop with the provinces a recommended wording for driver training manuals and, where necessary, wording for the underlying regulations. We further recommend that the need for harmonization of these regulations be brought to the attention of the appropriate committee of the Canadian Council of Motor Transport Administrators (CCMTA). We recommend that the CCMTA pursue changes to, and harmonization of, the content of provincial driver's handbooks and protocols followed in driver testing as they relate to railway crossings.

We further recommend that the wording used in regulations include a second distance constraint. In addition to the specifying "*stopping no closer than 5 m from the nearest track*", it should specify a *maximum of no more than 15 m.* This would prevent moving queues of vehicles and allow the detection system's speed threshold to be set much lower, thereby providing a more uniform and fair enforcement of non-stopping violations.

The impact of the dilemma posed at the onset of warnings at grade crossings (too close to safely stop when the FLB is first activated) could affect the overall safety impact of automated photo enforcement. The introduction of a penalty for a situation that already poses a dilemma to the driver could exacerbate the existing problems of unpredictable speed variation in approaches to grade crossings. If automated photo enforcement is pursued further at grade crossings, we recommend that drivers in the dilemma zone be allowed to pass through without incurring a fine, and to advertise the fact in awareness campaigns to minimize the chances of rear-end collisions. This could be handled by using the same wording as exists for amber stage traffic lights (i.e. drivers must stop if it is safe do so). Where this or similar wording does not exist, we recommend that a suitable grace period be provided in the implementation of automated photo enforcement systems.

The cost-effectiveness of automated photo enforcement at non-gated FLB crossings needs to be assessed and compared with other technological investments made at grade crossings to enhance safety. With the data collected at RR-232, it would make an ideal test site for an upgrade to constant warning time operation to get a consistent set of data for comparison.

The technology warrants further evaluation at non-gated FLB grade crossings that have identified problems of driver behaviour. Longer term tests are recommended at a non-gated FLB crossing in a jurisdiction that provides for ticketing and allows drivers to proceed when it is safe to do so. To our knowledge, no such jurisdiction currently exists in Canada.

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GLOSSARY OF ACRONYMS

ACS	Affiliated Computer Services
ASM	Alternative Safety Measure
CCMTA	Canadian Council of Motor Transport Administrators
CN	Canadian National Railway
CWT	Constant Warning Time
FLB	Flashing Lights and Bells
FRA	U.S. Federal Railroad Administration
Frt	Freight
ICC	Illinois Commerce Commission
ITE	Institute of Transportation Engineers
MBL	Metro Blue Line
MTA	Los Angeles Metropolitan Transportation Authority
NPV	Net Present Value
O&M	Operations and Maintenance
Pass	Passenger
RCMP	Royal Canadian Mounted Police
RLR	Red Light Running
RR	Range Road
SSM	Substitute Safety Measure

1 INTRODUCTION

1.1 Background

Automated signal enforcement devices have been used widely in Europe for highway traffic violations since the 1970s and in the U.S. and Canada since the 1980s. The application to railway grade crossing is more recent in the U.S. The installation of auto-enforcement at one site on Los Angeles County's Metro Blue Line demonstrated a 92 percent reduction in violations and further reports of overall reductions of collisions by 72 percent have been cited.

The initial results from California's installation were encouraging enough that the U.S. Federal Railroad Administration (FRA) has identified automated photo enforcement as a possible alternative to engineering upgrades in its acceptance of whistle bans. They note that more data is needed to establish a relationship between reductions in violations and reductions in collisions. Additional field trials can contribute to the global database and understanding of the relative effectiveness of automated photo enforcement.

Automated photo enforcement of red-light-running (RLR) and speeding was successfully introduced in Alberta and Strathcona County in the mid-1990s. It has been well received and reported to be effective in reducing violations. There are no installations at grade crossings anywhere in Canada at this time. This study is designed to assess the effectiveness of automated photo enforcement at grades crossings in the first pilot test in Canada.

1.2 Objectives

To investigate, demonstrate and evaluate the effectiveness of automated photo enforcement technologies in improving grade crossing safety.

1.3 Report Layout

This report presents the results of the pilot project evaluation, including a discussion of the relevant technologies and attributes of particular importance to the grade crossing situation. The document is presented in seven chapters.

Chapter 2 presents a review of the technologies.

Chapter 3 draws insights from the literature and discusses the performance of different technologies in previous grade crossing installations.

Chapter 4 discusses the Strathcona County pilot project.

Chapter 5 discusses the differences drivers encounter at grade crossings.

Chapter 6 presents observations from the data.

Chapter 7 presents an assessment of the impact on driver behaviour.

Chapter 8 states our conclusions and recommendations.

2 TECHNOLOGY REVIEW

Technology components involve

- Violation detection
- Violator identification
- Citation processing

Each is discussed in turn in the remainder of this chapter.

2.1 Violation Detection

Violation detection requires the detection of the presence of a vehicle passing into an intersection. While a simple loop detector could register that a vehicle had passed into an intersection, a fairness criterion usually requires that a violation involves fully passing into the intersection at a sufficient speed to indicate that stopping was not intended. Thus, most highway intersection systems involve a measurement of both presence and speed. Typically the evidence required involves three photographs:

- showing the vehicle behind the stop line while the red light is on,
- showing the vehicle having entered the intersection with the red light on,
- a close up of the vehicle license plate to identify the registered owner (some jurisdictions also require a picture of the driver's face).

Additional information shown on a citation includes time of day, location of the violation, and the speed of the vehicle.

There are a number of technologies used in the detection of a violation. The most commonly used technology is inductive loops. However, piezoelectric strips, video loops and lasers have also been used.

Buried inductive loops are widely used for a range of vehicle detection purposes. The loop of electrical wire serves as a metal detector for vehicles passing over it. They are buried in the pavement and are selected for their low cost and ease of maintenance. They have been adapted to the more complex task of presence detection and speed estimation necessary for red light violation enforcement by using twin-loops that are sequentially polled by a computer interface to determine vehicle presence, speed and in some cases the magnetic signature of the vehicle. Red light enforcement systems meet a requirement of speed accuracy of +/- 2 km/h. Suppliers take different approaches in meeting this accuracy requirement. Some inductive loop systems come with piezoelectric strips, which are not fully buried but are imbedded in the surface of the pavement. They detect wheel presence by generating an electrical current when deformed. Two adjacent strips can accurately measure crossing speed, but loops are required to assess the total vehicle length regardless of the number of axles. Given the extra expense and maintenance of piezoelectric strips, some loop systems use software to improve the speed measurement and to exclude those violations where speed is not accurately known.

Other than speeding,[1] intersection violations can involve two situations, demanding different speed accuracy. The two categories of violation are:

1) those where it is illegal to proceed into the intersection, and

2) those where one can legally proceed but must first stop.

In the first situation, speed is less relevant and gross estimates might be used while still providing evidence that a vehicle entered and was proceeding through an intersection while a red light was displayed. Examples of these situations are going straight through a red light at a road intersection and going around gates at a railway crossing. Speed measurement might be deemed desirable as a component of evidence. A higher speed indication also adds weight to the driver's intent to pass through the intersection (although an absence of brake lights in the picture also provides evidence of whether the driver was attempting to stop).

Supriyasilp et al. undertook an assessment of speed accuracy of Precision Traffic Systems' loop-based system for the state of Alabama in its evaluation of RLR automated photo enforcement [Supriyasilp et al., 2004]. They found that a high level of accuracy is not required. The legal requirement in Alabama[2] is to show a picture of the vehicle behind the stop line while the red light is visible and a second picture showing the vehicle in the intersection. The loop system was fully capable of getting these two pictures.

> *The study concluded that the RLR speed detection inductance loops were so close to the stop bar that the system was relatively insensitive to errors in speed measurement. It could accommodate a 24.5 percent speed estimate inaccuracy without a false identification of a violator, and the RLR system's speed estimates were far superior to that.*

Thus, the speed accuracy constraint placed on automated photo enforcement equipment by road authorities is not required to accurately detect non-stopping violations. The presence of the speed accuracy constraint leads to suppliers' systems eliminating vehicles with speed variation from citation processing. As vehicle speed is irrelevant to detecting a non-stopping violation, and leads to reductions in valid citations, we make recommendations in section 5.1, that road authorities eliminate (or significantly relax) this specification.

In the second situation (failing to stop), one requires evidence that the vehicle failed to stop before proceeding. Examples of this situation are right turns on red at road intersections and safely proceeding through a railway crossing with flashing lights. In these cases, a vehicle could stop before the detection system and accelerate over the detection system in proceeding into the intersection. Most systems provide a non-zero speed allowance to accommodate this situation. Again, the accuracy of the speed estimate is not as important as with a speeding violation but a reasonable estimate might be necessary to convince judges of the integrity of the technology being used.

Video loop technology uses software to monitor vehicle motion in-and-out of user-defined areas (virtual loops) of a digital video camera's view. A number of jurisdictions have installed

---

1 "Speed-on-green" is a third violation, and most automated photo enforcement systems offer this third enforcement option.

2 There are variations in the definition of the position the vehicle must be photographed in to be considered outside the intersection when the red light is first activated.

video loop technology for intersection traffic monitoring and enforcement. The grade crossing pilot projects in Los Angeles and Illinois both tested video loop technology and both found it to present detection problems in those applications. The problems appear to be related to vehicle paths aligned with the tracks when going around gates and long vehicles making turns. In the situation of driving around gates, the system had problems discerning motor vehicles from rail vehicles and experienced false detection of rail vehicles. The long-vehicle-turning problems emanated from the fact that long vehicles did not fully enter the defined video loop area and missed detection. While video loop technology did not perform well in these scenarios, the situation being tested in the present pilot test involves violators passing directly through the intersection perpendicular to rail vehicle movements through the intersection. This scenario avoids the limitations exhibited at the Los Angeles and Illinois grade crossings.

Laser beam technology has been installed in automated photo enforcement of red lights in Israel, Germany and the U.S. Laser technology is also used for speed enforcement. Infrared laser beams have also been used in grade crossing enforcement installations at Jonesboro, Arkansas, and Ames, Iowa [Lammert, 1999]. In each of the grade crossing cases, they were used in conjunction with a fully digital system with remote downloading of data. Their selection was based more on the remote access attributes of the supplier's technology than on the infrared detection component of the technology. The infrared components were problematic in the Ames installation during cold weather and were replaced with inductive loops. The complete installation in Jonesboro was abandoned and not maintained after camera images became blurred and the performance of the infrared system was not monitored.

2.2 Violator Identification and Citation Processing

2.2.1 Identification

The technology chosen by different jurisdictions is highly influenced by the laws applicable in that jurisdiction and in the preferences of the local enforcement agency. Legal requirements vary – some jurisdictions require both front and rear views, some require a picture of the driver. Even with the same laws, some enforcement agencies demand a continuous video and manual review of the video evidence to assess the validity of a citation.

Wet film technology uses a 35 mm camera with standard film that needs to be retrieved and developed. It was superior to the digital technology available at the time automated photo enforcement was first installed in the late 1980s / early 1990s. While digital technology has advanced to the point of being competitive in picture resolution, wet film is still offered and remains the more economical choice for some jurisdictions.

Digital still pictures are offered as an option by all suppliers and as the only choice by those that are based on remote monitoring and automatic processing. Some jurisdictions require a full motion video of a violation and digital video systems are available as a component of systems where this is a requirement. The principal advantage of digital cameras is the cost of processing, while wet film cameras have an advantage in first cost. The choice between digital and wet-film cameras is often a business decision that will vary from site to site.

2.2.2 Processing

Fast processing of violations is seen as important to get the most out of the educational component of the citation. It is also important from a public acceptance viewpoint, particularly in jurisdictions that do not take pictures of the driver. Fully automated digital systems with digital cameras and remote downloading of the data via wireless or other digital communication lines have an advantage from this perspective. However, the economics will vary considerably from site to site and the decision is often based on whether the communications infrastructure and central processing hardware already exist for other purposes. The economic tradeoffs involved are illustrated in section 3.1.

Some jurisdictions do not permit automated processing and require the photo evidence of every violation to be reviewed by a law-enforcement officer before a citation is issued. The issues associated with this approach are not unique to grade crossings and are not dealt with in this report.

3 PREVIOUS GRADE CROSSING INSTALLATIONS

3.1 Illinois Pilot Program

The state of Illinois undertook four separate pilot projects [Illinois Commerce Commission, 2002]. The tradeoffs between first cost and annual processing costs are illustrated in Table 1, which presents the costs for three of the four systems deployed in Illinois. The characteristics of the four technologies and sites are summarized in Table 2.

A couple of observations can be drawn from the two tables. The first is that the three systems with cost information available exhibited similar total costs over the 24 month demonstration period. The lower first cost of the manual retrieval wet-film system at Wood Dale was offset by its higher annual costs over the subsequent operations phase. The economies of digital equipment and remote access improve with the longevity of the installation. However, the economic tradeoffs are tied to other site-specific circumstances that prevent generalization.

Table 1 Cost comparison from Illinois pilot projects

Site	Start up Date	Months of Operation as of Dec. 2001	Installed Cost (US$)	Cost of 24 Months O&M (US$)	Total Cost (US$)	Citations Issued	Guilty Decisions	Revenue as of Dec. 2001 (US$)
Naperville	July 2000	18	$277,000	$19,200	$296,200	719	635	$129,715
Winfield	May 2002	0	$265,350	$78,766	$344,116	0	0	$0
Wood Dale	Dec 1999	11	$110,000	$192,000	$302,000	762	355	$120,095
Total		**29**	**$652,350**	**$289,966**	**$942,316**	**1,481**	**990**	**$249,810**

Source: Illinois Commerce Commission (ICC), 2002

Table 2 Site and technology characteristics from Illinois pilot projects

Site	Supplier	Technology	Detection	Trains/day (Pass + Frt)	Road Vehicles / day
Downers Grove	Proscan	Digital (remote)	N.A.	71 + 79	13,400
Naperville	SAIC	Digital (remote)	N.A.	147	9,100
Winfield	Nestor	Digital (remote)	Video loop	58 + 52	300
Wood Dale	ACS	Wet film (manual)	Inductive loop	58 + 17	32,000

The second observation is that the Winfield site, with a very low traffic count, generated no citations. From this experience, the ICC cautioned other jurisdictions that it is "important to conduct a pre-implementation traffic study to gauge the quantity and nature of existing traffic law violations" [Illinois Commerce Commission, 2002].

The impetus for the Illinois study was to assess automated photo enforcement's potential as an alternative safety measure to locomotive horns. Many Illinois communities are interested in avoiding the loss of quiet zones that would be required under a proposed federal law requiring the use of horns at all grade crossings unless specific engineering countermeasures are taken to prevent violations at gated crossings [U.S. DOT/FRA, 2003]. From this perspective, the ICC study concluded:

> *While photo enforcement has proven its ability to deter violations, the current cost of the installations is a substantial impediment to their use statewide. In contrast, where applicable, median barriers at an average cost of about $60 to $70 per foot (or $12,000 to $14,000 for a typical crossing), are significantly less expensive than photo enforcement installations and can offer comparable effectiveness. Photo enforcement is likely to be implemented only at selected high-risk locations that have a history of collisions.* [Illinois Commerce Commission, 2002]

The above position is taken with respect to gated crossings where a barrier can prevent drivers from driving around gates. In the case of non-gated crossings, the use of enforcement might be more cost-effective compared with the alternative of installing gates and constant warning time track circuits. The present study collected data on the effectiveness of automated photo enforcement at a non-gated, flashing lights and bells (FLB) crossing; however, comparisons with other alternatives were beyond the scope of the present study.

3.2 Los Angeles Metro Blue Line

The Los Angeles Metro Transportation Authority (MTA) made one of the early and more successful applications of automated photo enforcement technology at grade crossings. The installation was evaluated as a means of addressing a recognized safety problem, but also related to a desire to retain a whistle ban as was the case for the Illinois study noted in Section 3.1.

The pilot projects and accident data were presented in a report prepared for the California State Department of Transportation and published by Meadow [Meadow, 1993]. Many of the safety problems are specific to that railway line but some of the problematic attributes are not unique. The installations involved a new light rail line that shared right of way with a freight line for part of its route and with arterial roads on each side for most of the route.

3.2.1 Safety Performance

The first three years of Metro Blue Line (MBL) operation resulted in 20 vehicle-train collisions and 4 occupant fatalities at the 23 gated crossings on the MBL, and a higher number of collisions at the MBL street running intersections.[3] Most of the train-vehicle collisions involved illegal left turns at normal signalized street intersections on those segments of the light rail line that ran down the boulevard between two arterial roads. Most of the relevant (i.e. non-pedestrian/non-suicide) fatalities at gated crossings involved second train events. These line segments were on a shared right of way with slow freight trains and ran parallel to major arterial roads on each side. The combination of crossing geometry, mixed-speed train operations and a new passenger line all contributed to the problems.

Figure 1 illustrates the geometry at a gated crossing where left turning traffic can easily pass between the gates. In many cases, the driver can see a slow (10 mph) freight train approaching the crossing. In some cases the driver can not see the faster (55 mph) passenger train coming on the second track because it is either blocked from view by the freight train or coming from

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[3] As a streetcar line, it ran through some intersections with normal highway intersection control lights rather than highway-railway grade crossing warning systems.

behind at a poor sight line. Many of the fatal accidents involved these types of second-train scenarios.

A similar situation exists at the street intersections. The gates shown in Figure 1 are not present at the street-running segments; a red left turn arrow is used to prevent drivers from making left turns. Again the driver might see that no traffic is approaching on the left side one-way road, but not realize there is train approaching from behind on the light-rail tracks.

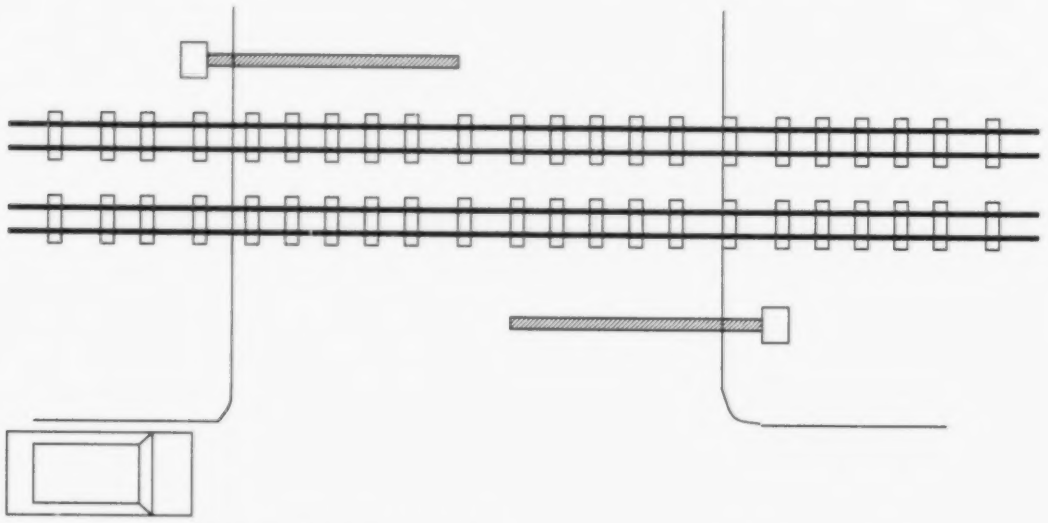

Figure 1 Illustration of left turn geometry

Following a manual enforcement blitz and a safety and awareness campaign, the MTA tested four automated photo enforcement pilot sites on the MBL: two at gated crossings and two at street crossings with restricted left turn signals. The two gated crossings were selected on the basis of their proximity to the courthouse, thereby accommodating easy processing of violations. Both of the gated crossings had low accident histories but high violation rates. The effectiveness in reducing violations was concluded to be very high—violation rates dropped from one per hour to one per 12 hours at one site and .5 per hour to .11 per hour at the other site. The low accident rate at these crossings prevents an assessment of the safety impact. However, following the pilot test, MTA installed automated photo enforcement systems at 17 additional gated crossings. The accident rate at all gated crossings averaged .48 per month in the initial 4.5 years of the new service and averaged .3 per month in the 2.5 years following the initiation of expanded automated photo enforcement. The cameras were phased in over two years and there was an average of one camera for every two equipped sites. The system supplier indicates that the accidents that occurred at gated crossings over the 2.5 year period involved crossings that did not have operational cameras. While the reduction in accident rate is a result of a many-faceted safety improvement program undertaken by the MTA, some portion can be attributed to the presence of automated photo enforcement.

The effectiveness at the normal street running intersections was less effective in terms of violation reduction—violations dropped from 2 per hour to 1.34 per hour. While the violation

and accident rates were high at these intersections, lower train speeds on these line segments resulted in a lower fatality/accident ratio than on the higher speed segments with gated crossings. In fact, no fatal vehicle accidents were reported on the street running segments of the line in the seven years of operation reported.

3.2.2 Citation/Violation Ratio

The pilot systems realized an average ratio of 29 percent of recorded violations leading to citations issued. The range varied from a low of 10 percent to a high of 47.7 percent. About 40 percent of the violations were not acted on because the camera did not get a good picture of the driver. This loss is not relevant in jurisdictions that do not require a picture of the driver. About 20 percent were inadequate due to uncontrollable causes. This category was dominated by lack of a front licence plate. This component could be eliminated by installing a second camera to insure that a rear-plate picture is always taken, but would still be a problem in those jurisdictions that require both front and rear plates to be recorded. About 5 percent of the pictures taken were deemed not to be violations, and another 5 percent were not issued due to local policy.

Those excluded by policy included any violations that occurred more than 99.9 seconds after the warning system was activated. The system did not allow one to discern whether the gates were inoperable or not, and the policy decision was made to assume the train had either stopped or the gates were malfunctioning. It also excluded by policy all violations that involved police vehicles. Special attention was given to school buses and public transit vehicle violations to ensure that a citation was warranted.

3.2.3 Violation Definition

In addition to excluding violations occurring after a 99.9 second warning time, vehicles that cleared the crossing in the first 5 seconds of warning initiation were also excluded. This time was later raised to a minimum of 6 seconds for the system wide installation and reflects the local circumstances of parallel highways on both sides of the right of way. Vehicles can be in the crossing approach making a left turn and waiting for traffic to clear on the far side. Enough time was required for these vehicles to clear the crossing. The time allocation also ensures that the gates have been activated and are visibly lowering, since drivers can legally proceed through the flashing lights if it is safe to do so. Similarly, no citations were issued for drivers driving under a rising gate after a train had passed. A speed threshold of 5 mph (8 km/h) was imposed to eliminate vehicles that have "stopped due to traffic congestion or other factors".

3.3 Los Angeles Metrolink Commuter Line

The results of an automated photo enforcement test on a heavy rail commuter line in Los Angeles County were less impressive than on its streetcar line. Metrolink tested two busy intersections. The first was located at Van Nuys Boulevard, an arterial with 22,000 average daily motor vehicle trips and 28 daily weekday trains. The second system was shared between Chestnut Avenue, a feeder/collector street with 7,000 average daily motor vehicles and 72 daily weekday trains, and Goodwin Street, a residential street with 4,600 average daily motor vehicle trips and 76 daily weekday trains.

Compared with the light rail sites that exhibited one violation per hour, the commuter rail line crossings averaged one violation every two days. Violations were recorded at seven seconds after initiation of the warning devices at crossings. According to the FRA's review of automated photo enforcement as a component of its Interim Final Rule on Locomotive Horns [U.S. DOT/FRA, 2003]:

> *During the initial benchmark period (one month), the sites averaged 0.5 daily violations. At the end of the enforcement period, the sites averaged 0.46 daily violations. Violations decreased by 8 percent. According to Metrolink, 96.5% of the violations occurred before twelve seconds it takes a gate to come down completely. Metrolink concluded that most motorists are racing against gates and not trains.*

3.4 FRA's Position on Automated Photo Enforcement and Whistle Bans

In its Interim Final Rule on Locomotive Horns [U.S. DOT/FRA], the FRA designates automated photo enforcement as an Alternative Safety Measure rather than a Substitute Safety Measure (SSM) for communities seeking a whistle ban. The difference being that SSMs are approved engineering alternatives that are deemed to be an effective substitute at any gated crossing, whereas Alternative Safety Measures are non-engineering alternatives that must be assessed for effectiveness on a crossing-by-crossing basis.

The FRA requires that communities that install automated photo enforcement systems as an ASM undertake ongoing effectiveness evaluations (every second calendar quarter) to demonstrate that the system continues to be an effective alternative to locomotive horns. The FRA considers automated photo enforcement systems to have a collision-reduction / violation-reduction effectiveness ratio of 0.78, based on the report written for the Los Angeles MTA pilot study of its streetcar Metro Blue Line [Meadow, 1993].

4 STRATHCONA COUNTY PILOT PROJECT

4.1 Range Road 232 at Wainwright Subdivision 257.14

The pilot site was selected because of the high number of non-stopping violations observed at the crossing. Range Road 232 (RR-232) is a two-lane highway with a 70 km/h speed limit. It serves a number of local industries that are located north of the community of Sherwood Park in Strathcona County. The highway traffic is largely composed of employees of the local industries and trucks that service the industries. The grade crossing is on Canadian National Railway's (CN) Wainwright subdivision, which is a single track main line. It has industrial spurs to the east of RR-232 and a diamond crossing with Canadian Pacific Railway, as well as its own major yard to the west of the crossing.

The crossing has an active protection system with flashing lights and bells but does not have gates. CN provided digital data on the activation of the FLB warning system as recorded from its control hardware mounted in the bungalow adjacent to the crossing.

Affiliated Computer Services (ACS) provided the automated photo enforcement hardware for the pilot project. It also provided the personnel to download the data collected on vehicle violations, retrieve the video recordings made of the crossing, and process the warning notices during the final phase of the pilot study. ACS used loop technology and a wet film camera system. A schematic of the RR-232 installation is provided in Figure 2.

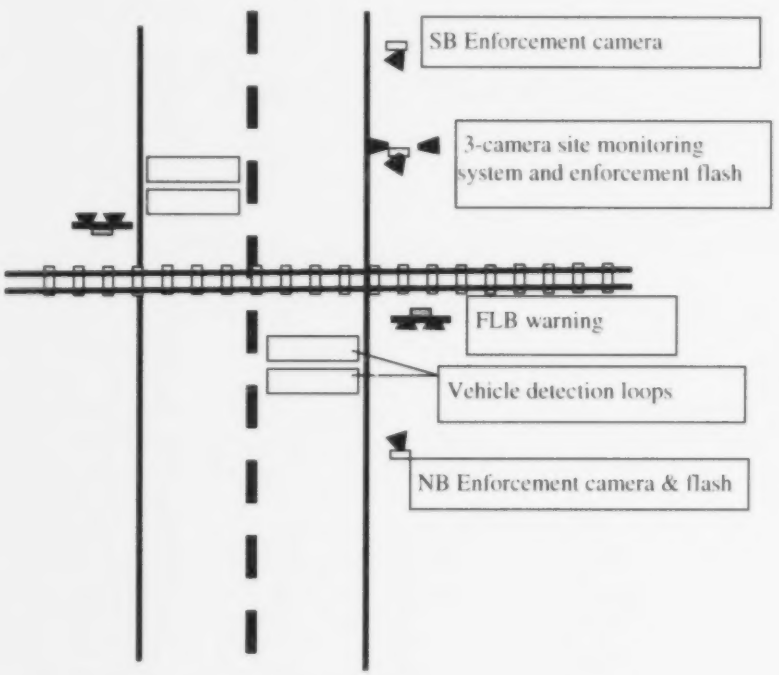
SB Enforcement camera
3-camera site monitoring system and enforcement flash
FLB warning
Vehicle detection loops
NB Enforcement camera & flash

Figure 2 Schematic of hardware installation

In addition to the still photographs taken by the ACS system for violations, three digital video cameras were installed to monitor train approaches and highway vehicles at the crossing whenever the warning system was active.

In other pilot projects at railway crossings, conventional highway intersection RLR technology has been transferred to a grade crossing application without change. This has not posed a problem for installations that involve gates or conventional highway signals. The selection of a non-gated crossing for the Strathcona County pilot project introduces additional opportunity to influence safe driver behaviour, but also makes more demands on the wording of the laws that are being enforced and on the technology that is used for auto enforcement. These aspects are discussed in Chapter 5.

4.2 Awareness Program

Prior to issuing warning notices for violations at the crossing, Strathcona County and the Royal Canadian Mounted Police (RCMP) undertook an awareness program composed of three elements:

1. Information brochure
2. Highway signs
3. Media release

Information Brochure
An information card/brochure was distributed to motorists who regularly use the road. The distribution was coordinated by the RCMP via direct contact with the three main industries that are serviced by RR-232. The content of the brochure is presented in Figure 3.

Awareness Signs on Highway Approaches
Two signs were installed on each of the approach directions one week before warning notices were being issued to detected violators. The first sign *Flashing red means stop* was located further back from the crossing, followed up by the more detailed message...*Flashing red means stop...WAIT until the train has passed or stopped and it is safe to proceed* closer to the crossing (see Figure 4).

Media Release
Also one week before the practice of issuing warning notices was initiated, a media campaign was conducted. An announcement (see Appendix A) was released to the local media and an invitation was extended to them to cover the event and ask any questions of the RCMP (see Figure 5).

In addition to the formal announcement and media interviews with the RCMP, a question and answer sheet was prepared as a guide for anyone who might be answering questions on the project (see Appendix B).

Flashing RED means STOP

It's the law

It is a traffic violation not to stop when railway crossing lights are flashing. Section 42(2) of Alberta's Use of Highway and Rules of the Road Regulation states:

Where a railway train is approaching a railway crossing, a person driving a vehicle that is approaching the railway crossing

(a) shall stop the vehicle no closer than 5 metres back from the nearest rail of the railway, and

(b) shall not proceed to drive the vehicle across the railway crossing until the train has passed by the railway crossing or has come to a stop and the vehicle can be driven in safety across the railway crossing.

You should also be aware that it is a $230 fine for not stopping when the lights are flashing.

It's a matter of safety

From 1998 to 2002 in Alberta, 25 people were killed in collisions involving trains, and 179 were injured.

Many motorists misjudge the speed of trains, commonly believing they are travelling much slower than they actually are.

Many collisions involve regular users of a crossing. Trains don't always run on schedule, and extra trains can cross at any time.

Many collisions take place at multiple tracks. Be cautious. The train that has passed or stopped may not be the only train approaching.

...over

The Railway Crossing Camera Pilot Project: a first in Canada

In recent years safety cameras have been installed at major traffic intersections. In Strathcona County at intersections with these cameras, the trend has shown a reduction in collisions, running of red lights and speeding. The combination of education, engineering and enforcement is having an effect.

Now, to determine whether similar improvements can be achieved at railway crossings, cameras have been installed northbound and southbound at the CN tracks crossing Range Road 232 north of Highway 16.

These cameras photograph vehicles that fail to stop while the red lights are flashing.

Since cameras were installed at this location in October 2003, an average of 113 motorists per month have been recorded failing to stop for the flashing red lights.

Warning notices will be mailed to the owners of vehicles that fail to stop when the lights are flashing. The notices are being sent in order to make drivers aware of the legal and safe procedures at railway crossings.

Further information

467-7741 – Strathcona County RCMP

Our partners

These organizations are pleased to participate in the Railway Crossing Camera Pilot Project.

Transport Canada Transports Canada

ACS

Alberta Transportation

CN

RCMP GRC

Strathcona County

DIRECTION 2006

Saving lives along Canada's railways

Canadian Pacific Railway

Alberta Traffic Safety Foundation

Alberta Centre for Injury Control & Research

October 2004

Figure 3 Information brochure used in awareness campaign

Figure 4 Awareness signs at RR-232

Figure 5 Site interview event

4.3 Automated Photo Enforcement Activation

The warning notice that was sent out to violating vehicle owners was the same format as used in violation citations. It included the evidentiary pictures: one of the vehicle in front of the stop line with the red light activated and a second of the vehicle proceeding through the crossing while the flashing lights are still activated. Two example pictures from the RR-232 site are presented in Figure 6 and Figure 7. The date and time of day is shown at the top of the pictures. The time since the red light activation is shown on the right side of the pictures, while the second picture adds the vehicle speed (64 km/h) and the time interval from the first picture (0.6 sec).

Figure 6 First picture of non-stopping violation

Figure 7 Second picture of non-stopping violation

5 RAILWAY CROSSING ENFORCEMENT CHARACTERISTICS

Many of the issues of automated photo enforcement at railway grade crossings are generic ones that can be and/or are being addressed in the wider application to RLR and speeding. The selection of Strathcona County for the demonstration site provides an environment where many of the required steps have been initiated for the general principles of auto enforcement. This pilot test focuses on the unique and incremental problems posed in taking the technology to a railway grade crossing application.

The enabling legislation and legal status is an obvious requirement that was addressed in an unpublished working paper (phase 1 of this project). Privacy issues, provincial regulations, institutional framework and political elements of the generic automated photo enforcement concept were addressed in that phase. We address some of the key differences in the existing application of traffic laws as they apply to grade crossings and road intersections.

5.1 Road Vehicle Speed Variation

Many vehicles are accelerating or decelerating at grade crossings, often in response to the bump encountered; however, this can also be a cautionary speed reduction to look for trains. Consequently, systems that ignore violations by vehicles that are accelerating/decelerating will have a lower enforcement rate than those that can use rough estimates. Since a high level of accuracy has been found to be unnecessary in obtaining the required evidence (see section 2.1), we recommend that road authorities relax the speed accuracy specification for failure to stop violations, and that suppliers relax the present software constraints that exclude accelerating/decelerating vehicles from detection.

5.2 A Non-*dilemma* Warning

Luedtke has identified a "non-dilemma" change period that follows Institute of Transportation Engineers (ITE) guidelines as one key to the success of auto enforcement of red light intersections [Luedtke, 2001]. Luedtke advises that rules of thumb and open interpretation should be avoided in setting the pre-warning (i.e. yellow light) period. This requirement is a problem for the grade crossing case. While a non-dilemma change period can be easily determined, the method of implementing it is more of a problem. A key difference between road-road intersections and road-railway grade crossings is the lack of a pre-warning aspect in the railway case. Grade crossings do not have the yellow change of state pre-warning that exists at road-road intersections. Drivers who are close to a railway crossing when it starts to flash are faced with a dilemma of whether to stop (knowing they cannot do so safely and/or comfortably) or to keep going and break the law.

The delay in gate activation at gated crossings could be interpreted as a pre-warning period that is compatible with the statement of the law, and has been designated as such in the Los Angeles installations. However, conveying this to the public is a major challenge.[4] The complexity is exacerbated by the fact that the red flashing lights that must be interpreted as a

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[4] While the wording of the law allows a pre-warning interpretation, we note that the Alberta driver's handbook calls for a stop as soon as the lights begin to flash at gated crossings. It would be difficult to openly interpret this pre-gate-activation interval as a pre-warning in an Alberta test of gated crossings.

pre-warning at gated crossings have no pre-warning element at non-gated crossings and no latitude in the wording of the law.

The impact of the dilemma posed at the onset of warnings at grade crossings goes beyond aspects of public acceptance and fine-validity/fairness; it could affect the overall safety impact of auto enforcement. The introduction of a penalty for a situation that already poses a dilemma to the driver could exacerbate the existing problems of unpredictable speed variation in approaches to grade crossings. The lack of a pre-warning at grade crossings is one factor in the accident statistics at grade crossings. Schoppert and Hoyt first identified the phenomenon that two thirds of the accidents that occur at grade crossings do not involve trains but are due to driver uncertainty and inter-vehicle speed variation approaching crossings [Schoppert and Hoyt, 1968]. Dodson found similar ratios in an updated 1989 study and in an assessment of the influence of school bus stopping policy in 1996 [Dodson, 1997].

Golob et al. found that the addition of auto enforcement of RLR at highway intersections in San Diego increased the incidence of rear-end accidents [Golob et al., 2003]. They found that the 40 percent reduction in side impact collisions was almost equal to the increase in rear-end collisions in the early period of introducing automated photo enforcement. However, the side impact crashes have a higher injury ratio (46.4 percent produce injuries versus 33.7 percent for rear-end collisions). Thus, there was a net benefit from the auto enforcement, but they caution that:

> *the avoidance of rear end crashes through advance warning signs and public information campaigns are indicated as a necessary part of a photo enforcement program.*

Raub et al. report of some evidence of driver confusion when presented with a new warning device at a grade crossing [Raub et al., 2003]. After a wayside horn was positioned at a grade crossing and sounded at the initiation of the FLB warning system, there were six instances of drivers stopping on the tracks and waiting for up to 12 seconds trying to decide whether to back up or proceed.

As noted previously, the enforcement systems used in Los Angeles were set such that the initial 5 to 7 seconds of warning was not treated as a violation—although the motivation was to ensure that the lowering gate was visible in the photographs as evidence the gates were functioning properly.

The Strathcona pilot project allowed a 4.5 second grace period for drivers who were too close to the crossing to safely stop at the onset of warning. This is consistent with the one second reaction time and prescribed braking rates for signalized highway intersections. The traffic level at the pilot site was low enough that it was unlikely for there to be many chances for rear-end collisions even if the lead driver arrived in the dilemma zone. If automated photo enforcement is pursued further, we recommend that drivers in the dilemma zone be allowed to pass through without incurring a fine, and to advertise the fact in awareness campaigns to minimize the chances of rear-end collisions.

5.3 Highway Regulations at Grade Crossings

Grade crossing warning systems involve a number of warning devices ranging from passive crossbucks to highway stop signs to active FLB to FLB plus gates. The legal definition of violations at grade crossings varies from province to province. Where gates are used, the laws uniformly require the driver to stop and wait for the gates to be raised before proceeding. In the case of non-gated FLB crossings, there is some variation in the wording of laws. In most cases the laws at crossings are based on two components:

1) one must stop when the warning system is on, and

2) one can only proceed if it is safe to do so.

Both components have some variation from province to province, with the second one sometimes having additional wording to clarify the conditions under which it can be interpreted as being safe to proceed.

The key difference in the first component is that, while all jurisdictions define a stop as being no closer than 5 m from the closest rail, a few go further to state that it should also be no more than 15 m from the closest rail. The addition of the second constraint helps to address the *follow-the-leader* response of queued vehicles proceeding without stopping a second time at the crossing. It also assists in automated enforcement systems. Without the second constraint, a driver could stop well before the loops and accelerate over them and through the crossing. To avoid technically invalid citations, the system must have a speed threshold that accommodates this action. In Strathcona County's situation a 22 km/h threshold was selected. If a regulation included the second constraint of a maximum of 15 m, the speed threshold could be set much lower, thereby providing a more uniform and fair enforcement of non-stopping violations.

5.3.1 Proceeding Safely

The acceptance of proceeding safely at non-gated FLB crossings is a result of the signal system technology and normal operations of railways. Trains can have a wide range of speeds approaching a crossing, they can also stop and reverse direction on main tracks as they perform switching duties into and out of industrial spurs.

The characteristics of the pilot test site were such that there were both *nuisance* alarms and extended warning times. The *nuisance* alarm resulted when the warning system was activated by switch-trains that did not arrive at the crossing. The high proportion of extended warning times was due to slow moving trains that had stopped at a nearby junction with another railway and were accelerating towards the crossing. These trains averaged speeds of less than 10 mph on the approach to the grade crossing after the warning system was activated. The low accelerations are a characteristic of the very low power-to-weight ratios used on freight trains in comparison with highway vehicles. The fixed distance track circuits that are used at RR-232 detect train presence but do not predict its speed or time of arrival at the crossing. Thus, the warning times for these very slow moving trains are much longer than for other trains.

The warning system at RR-232 is recognized as having potential for improvement but is also not unique. An active warning (i.e. track circuit activated flashing lights) that a train is nearby and might be approaching can be realized at a reasonable cost; however, the enhancement of the warning system to one that reliably indicates that a train's arrival is imminent can be quite

expensive. There is a trade-off in the level of expenditure for improved warning systems and in education of drivers to respond safely to less-than-perfect warning systems. A potential side benefit of automated photo enforcement systems is that they might be able to highlight and reinforce the education component of safe behaviour at non-gated FLB grade crossings.

A constraint to the effectiveness of automated photo enforcement technology is that it focuses attention on the literal wording of the relevant laws and leaves little scope for interpretation (which exists with manual enforcement). Depending on the wording of the law, this can be either a benefit or a detriment.

The Alberta requirement under section 42(2) of the *Use of the Highway and Rules of the Road Regulation* is:

Where a railway train is approaching a railway crossing, a person driving a vehicle that is approaching the railway crossing

> *(a) shall stop the vehicle no closer than 5 metres back from the nearest rail of the railway, and*
>
> *(b) shall not proceed to drive the vehicle across the railway crossing until the train has passed by the railway crossing or has come to a stop and the vehicle can be driven in safety across the railway crossing.*

The Alberta wording is consistent with other jurisdictions except for the words "*or has come to a stop*". This aspect makes it more difficult for an automated system to assess and verify a safely proceeding violation. The present wording can also lead to undue delays to drivers who are faced with situations where it is clearly safe to proceed but illegal to do so under the law. Our assessment methodology (subsection 7.4.2) recognizes the costs of driver delays associated with enforcement of the strict wording of the law.

The prevalent wording for regulations at flashing red lights at normal highway intersections is simply stated that driver shall not proceed until it is safe to do so. Those jurisdictions that have added conditions at grade crossings specifying "until the train has passed", and "until the train has stopped" provide added guidance to help drivers interpret safe crossing, which is helpful in jurisdictions where multiple tracks do not exist at grade crossings. However, in multiple track territory, a stopped train or a passed train can block the view of a second approaching train, or a visibly stopped train can be interpreted by a driver as the reason the warning system is activated and fail to look in the other direction for oncoming trains. These scenarios are similar to those existing in the high frequency of fatal collisions on Los Angeles's Metro Blue Line discussed in section 3.2. All jurisdictions include a clause similar to that in part b) above: that the driver assesses that the vehicle "can be driven in safety across the railway crossing before proceeding". This is the overriding condition, and is the only condition stated for normal highway intersections. Since drivers are not restricted to any geographic area, there is a significant benefit in having harmonized laws, regulations and educational content for highway usage. We see benefits in the simplicity and uniformity of the wording used at highway intersections. However, the conditions at grade crossings are much more complex and an assessment of safely proceeding requires education and training.

5.3.2 Role of Education

We believe changes need to be made to the underlying regulations and to driver education before strict enforcement of the law is applied at non-gated FLB crossings. We believe the range of situations that can exist at railway crossings is much too complex to be worded into laws and regulations. It is our opinion that laws dealing with complex situations should be kept simple and the details of the range of scenarios that can exist should be left to driver education programs. It is of interest that appropriate driver response to railway crossing signals, while involving a complex set of scenarios requiring driver interpretation and judgment is the smallest (and in many cases non-existent) component of most driver training manuals. We recommend that Transport Canada encourage provinces to highlight the various situations and complexities that exist at railway grade crossings and develop with the provinces a recommended wording for driver training manuals and where necessary, wording for the underlying regulations. We further recommend that the need for harmonization of these regulations be brought to the attention of the appropriate committee of the Canadian Council of Motor Transport Administrators (CCMTA).

5.3.3 Recommendation on Enforcement of Unsafely Proceeding

A number of instances of unsafe driver behaviour were observed at RR-232 during the initial hardware installation period. The unsafe behaviour did not involve approaching trains, but resulted from diverse responses to an activated warning system without a train approaching. Even though the enforcement system was not activated, drivers recognized its purpose. There was confusion among drivers as to whether they could proceed through the crossing when the flashing lights were activated and trains were either not moving or were visibly far from the crossing and moving at very slow speed. There were incidents of drivers passing long queues of vehicles at high speed and drivers passing on the ditch side to get by the queue when there was oncoming traffic. While there were no collisions, the confusion and resulting behaviour significantly elevated the risks of inter-vehicle collision at the crossing and distracted drivers from checking for train conditions as they got to the crossing.

We are concerned that this type of erratic behaviour could be repeated if the *unsafely proceeding* component of grade crossing regulations is enforced at locations with slow approaching trains activating long warning times. On the other hand, we believe unsafely proceeding is a violation that should and could be enforced, but in conjunction with a regulation that can be measured and an education program that provides drivers with the ability to assess what is involved in safely proceeding at a grade crossing.

In highway intersection applications of automated photo enforcement to right turn on red, drivers are assumed to be proceeding safely as long as a stop was made first. Judgment of safely proceeding in this case would be difficult to assess and monitor with an automated system. In a railway situation it is a simpler task to measure whether conditions were safe when a vehicle proceeds. More complex regulations might be required to differentiate unsafe behaviour once it is measured, or possibly the existing railway regulations and standards might be applied as the definition of safely proceeding.

We believe that traffic laws need to achieve a balance between specifying actions that are recognized as unsafe and allowing drivers to make fair and reasonable judgments in response to the wide range of circumstances they can encounter. Since there is some variation in

wording across provinces, it would be desirable to make an effort to harmonize provincial treatment of grade crossings, not only with regulations, but also the content of driver's handbooks and protocols followed in driver testing. Further to the recommendations made in subsection 5.3.2, we recommend that the CCMTA pursue changes to, and harmonization of, the content of provincial driver's handbooks and protocols followed in driver testing as they relate to railway crossings.

The clearance time between vehicle crossing and train arrival is a good indication of the hazard involved in proceeding through a non-gated FLB warning. Existing federal regulations applied at grade crossings indirectly define safely proceeding. They could possibly be accepted in the enforcement of provincial highway regulations. Transport Canada's *Highway Crossings Protective Devices Regulations* state under 12.(1) "warning signals shall operate for not less than 20 seconds before the crossing is entered by a train at a speed in excess of 10 mph"; and 12.(2) "not less than seven seconds before the crossing is entered by a train at a speed of 10 mph or less." The Transport Canada regulation provides a basis of defining the unsafe interval between a vehicle's departure from a crossing and the arrival of a train (i.e. an unsafely proceeding violation). Transport Canada's recommendation on standards (Draft Standard RTD-10) also notes the safety benefits of uniform warning times and recommends a maximum warning time duration of 35 seconds. This sets a threshold for safely proceeding. Thus, enforcement of the second part of a highway safety regulation that simply states "... and not proceed until it is safe to do so" could draw from the Transport Canada regulations for definitions of safely proceeding. If unsafely proceeding violations were tied to severity like speeding, its enforcement could use a fine that decreases in magnitude with increasing train clearance time until reaching a zero fine at 35 seconds.[5]

The clearance time interval at non-gated FLB crossings can also be easily derived with automated systems. Each train's arrival at the crossing is detected by track circuits, and a highway vehicle's clearance time can be directly measured with departure loops, or calculated from the speed and departure time at the entrance loops that are normally used by the automated photo enforcement system. Where the objective of the system is to discourage risky behaviour, detecting and enforcing high-risk stop-and-go violations would be an important attribute of a system.

While the present technology does not provide a means of automatically detecting unsafe stop-and-go violations, enforcement could be realized by manually reviewing the video recordings. Since the main safety concern at the pilot site was that people were essentially ignoring the flashing lights and not stopping, and because an automated measurement of violations of the safely proceeding regulation was not accommodated by the enforcement system, the second violation (unsafely proceeding) was not enforced during the pilot project.

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5 Enforcement could be undertaken either manually or by automated means. Under manual methods, the enforcement officer would use a stopwatch to record the time between highway-vehicle clearance of the crossing, and train arrival at the crossing. Specifically, the stopwatch would be started when the end of the vehicle (regardless of its length) is clear of the crossing (the 5 m stop line on the adjacent lane could serve as a surrogate for "clear" distance). The stopwatch would then be stopped when the train arrives at the crossing. If this time interval is less than 20 seconds (7 seconds for train speeds less than 10 mph), a violation of the safely proceeding regulation exists. If the time is greater than 35 seconds, no violation exists. The best feedback to drivers would be a scaled fine that decreases from the maximum at times less than 20 (or 7) seconds to zero for time greater than 35 seconds.

In the long term it would be desirable to enhance the technology to detect train arrival times. We recommend that both the regulations and automated photo enforcement technology be modified to facilitate the definition and enforcement of unsafe stop-and-go violations if the technology is to be used at non-gated FLB crossings.

6 OBSERVATIONS FROM THE DATA

6.1 Characteristics of Driver Violations

This section provides some details of the data collected before warning notices were sent out, particularly for the violations as defined in the warning notices; that is, *non-stopping* violations, defined in this location as vehicles that enter the grade crossing against a flashing red light at a speed exceeding 22 km/h, and after the initial grace period of 4.5 seconds.

6.1.1 Vehicle Speeds

Figure 8 illustrates the speeds of violating vehicles for an eight month observation period (3 Oct. 2003 to 17 June 2004), while Figure 9 illustrates the speeds of vehicles that crossed within the first 4.5 second grace period. Both figures are presented in a stacked bar format. Thus, for the 23-29 km/h speed range (first column in Figure 8), there were a total of 249 drivers, 81 northbound and 168 southbound. The speed limit is 70 km/h in each direction. One can see that there is a general reduction in speeds after the initial 4.5 seconds. The median speeds for the post-4.5 second interval are 35 km/h northbound and 32 km/h southbound, compared with 45 and 38 km/h, respectively, during the initial 4.5 seconds. The lower southbound speeds could be an indication of the longer acceleration distance from entering the highway in the northbound direction, or could be an indication of better track sightlines when northbound. The average speed measured during the first 4.5 seconds of warning activation is very close to the speeds obtained from road counters when the signal system was not activated. By contrast the average speeds obtained from road counters at a distance of 80 m from the crossing was about 60 km/h for each direction when the signal system was not activated. The data indicate that, on average, drivers slow down at the grade crossing even when the warning system is not activated. This could be a cautionary action or it could be a concern for the possibility of a bump at the crossing.

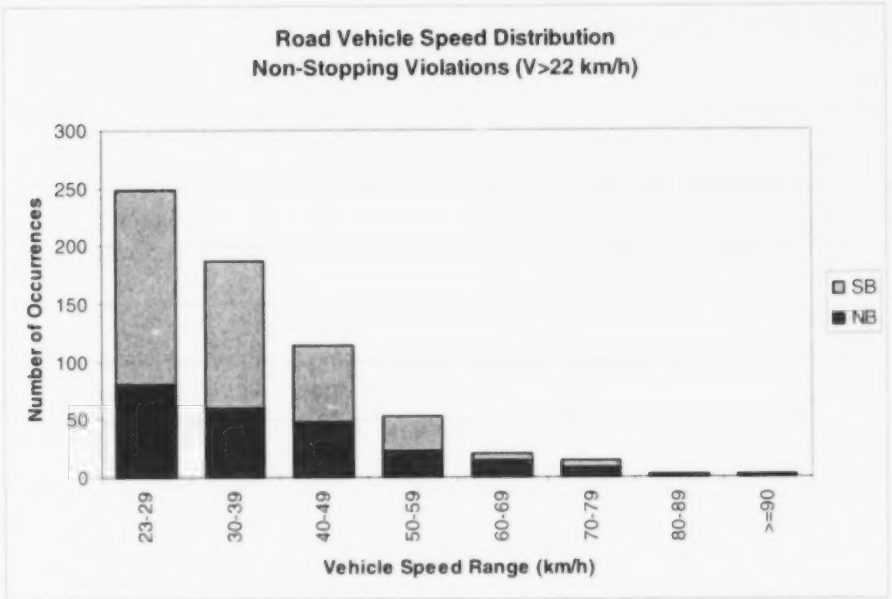


Figure 8 Southbound and northbound violators' speed distribution

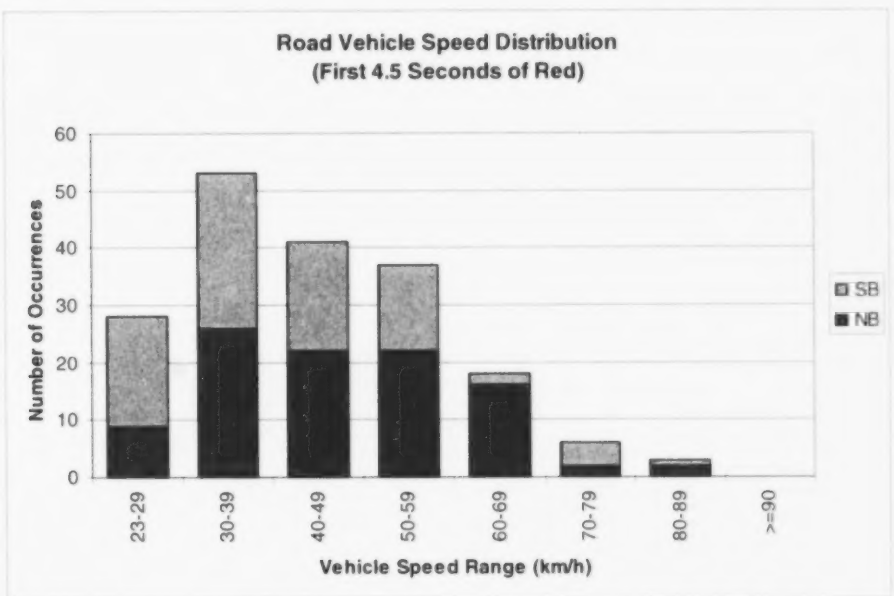


Figure 9 Speed distribution in the first 4.5 s. grace period

6.1.2 Elapsed Red Times

Figure 10 illustrates the distribution of elapsed warning times for those vehicles crossing at a speed greater than 22 km/h. About 25 percent of the occurrences happen at each end of the distribution (i.e. less than 4.5 seconds, or greater than 99.9 seconds). One can see in Figure 10 that the southbound direction has a higher occurrence of violations in almost all warning time categories. For example, in the third category of (10 to 20 seconds) there were 63 southbound versus 32 northbound violations. In total there were 490 violations for southbound drivers versus 338 for northbound. The majority of drivers are going to work in the northbound direction and returning from work in the southbound direction.

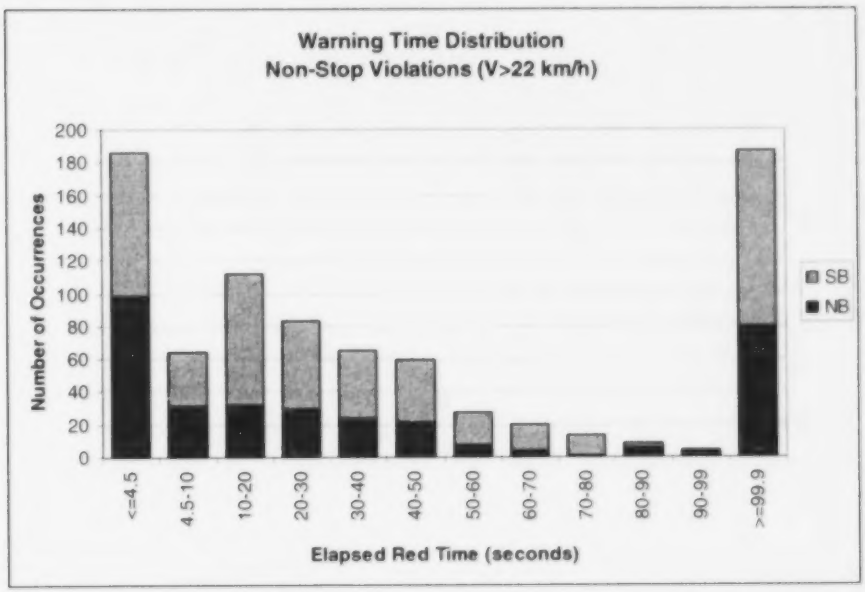


Figure 10 Elapsed red times

The average weekday violations are plotted by month in Figure 11 and Figure 12 for the northbound and southbound directions, respectively. The data have been adjusted for statutory holidays but not for other low traffic times. We know that December, January and March would have been lower traffic months. The large number of violations in October 2005 included data for a nuisance alarm that was responsible for about half of the "*red>100*" violations for the month.

The total violation counts by day of week for the first nine months are illustrated in Figure 13.

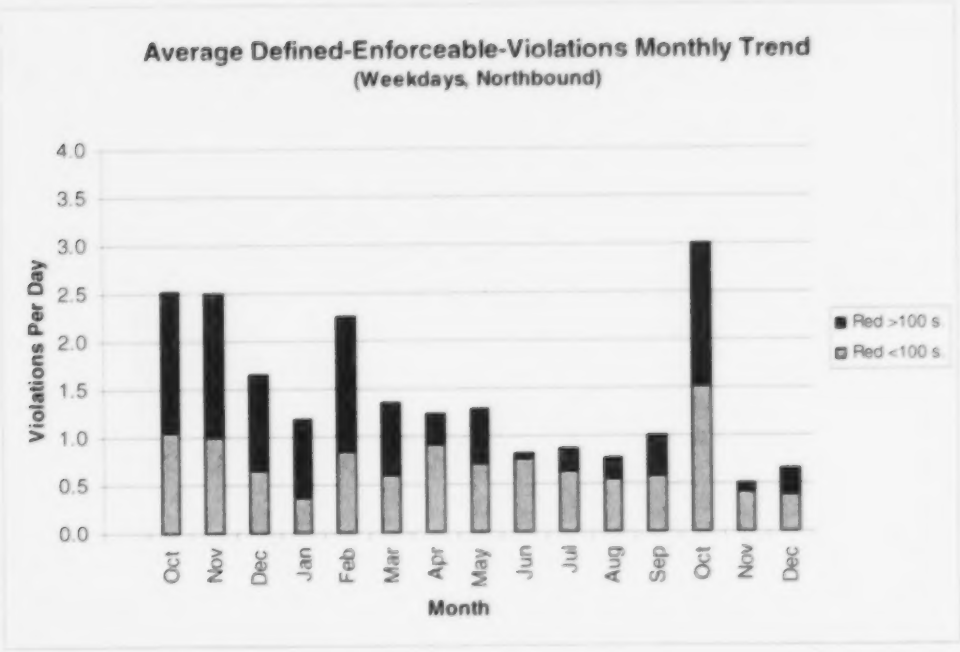


Figure 11 Northbound weekday violation trend

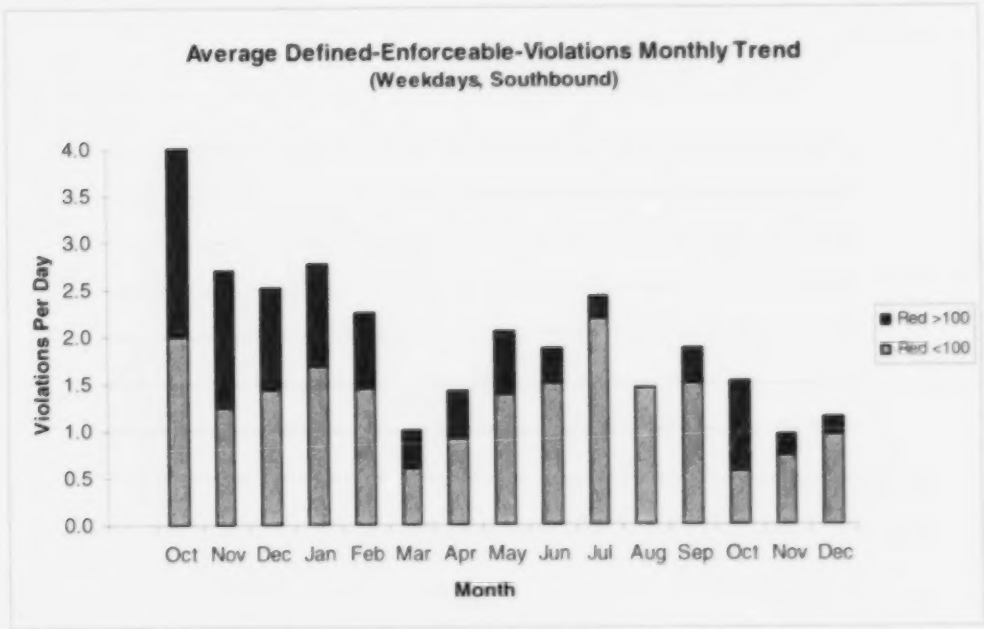
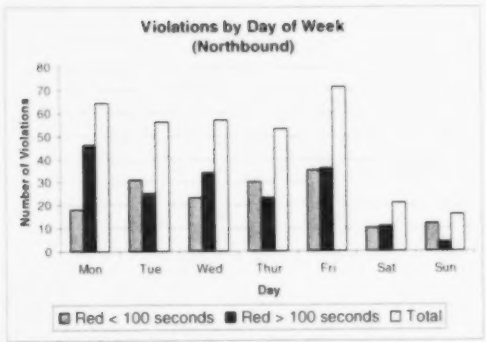


Figure 12 Southbound weekday violation trend



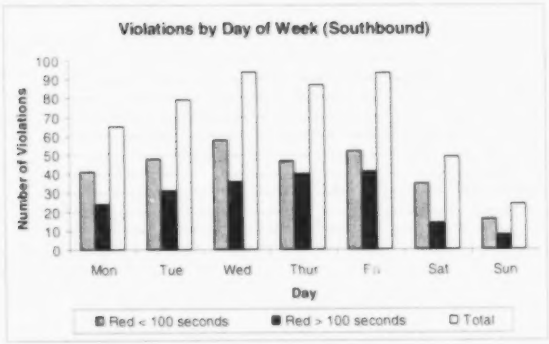


Figure 13 Violations by day of week

6.2 Highway Traffic Characteristics

The highway counters installed at RR-232 for a one-week period provide an insight to the time-of-day distribution of traffic. The vehicle counts were aggregated into 10-minute intervals. Figure 14 illustrates the variation of traffic by time of day in the northbound direction for weekdays and Figure 15 illustrates the same information for the southbound direction.

The northbound traffic is seen to be tightly peaked at 6:50 and to a lesser extent at 7:30. The southbound direction is more evenly spread across the afternoon and also has more variability as indicated by the difference between the maximum count and the average count for the measurement period.

The average weekday traffic during the measurement period was balanced at 907 vehicles southbound and 931 vehicles northbound. These averages (for a week in July) were higher than the reported average-annual-weekday-traffic volume of 1,200 vehicles for the two directions combined.

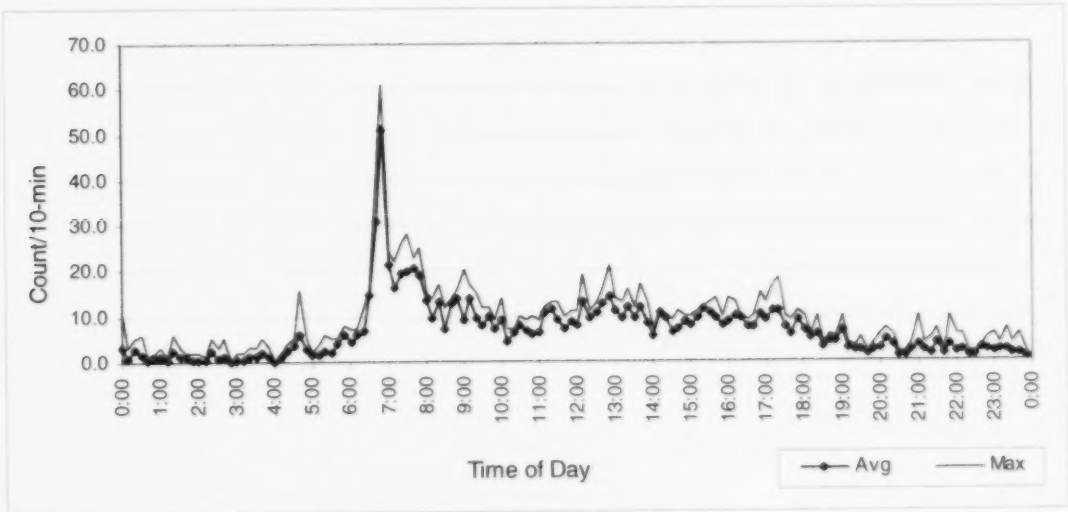


Figure 14 Northbound traffic variation for weekdays

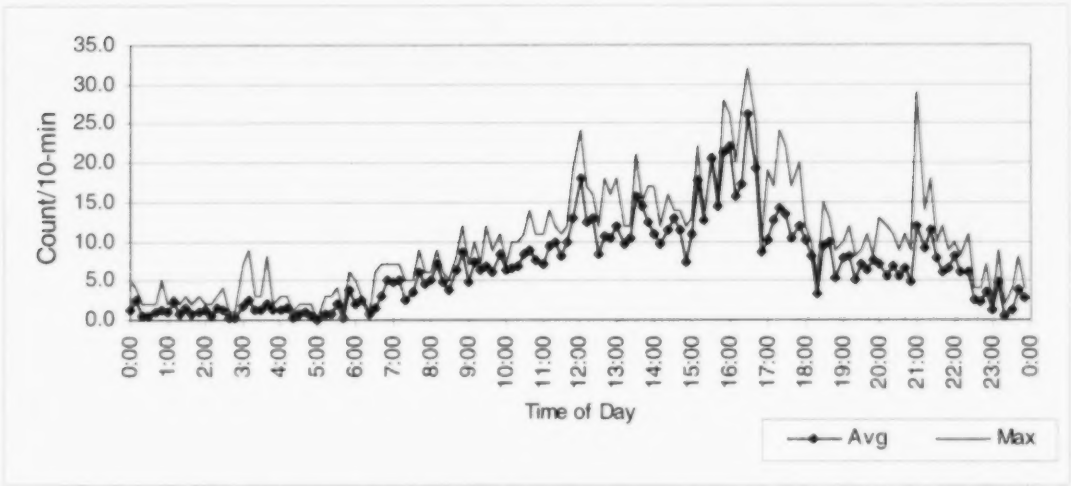


Figure 15 Southbound traffic variation for weekdays

Figure 16 and Figure 17 provide the same information for weekends and holidays in the northbound and southbound directions, respectively.

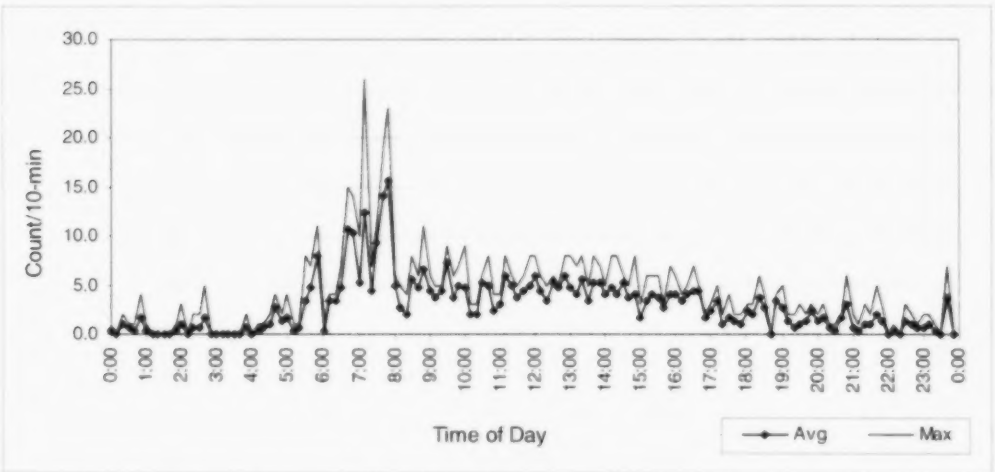


Figure 16 Northbound traffic variation for weekends

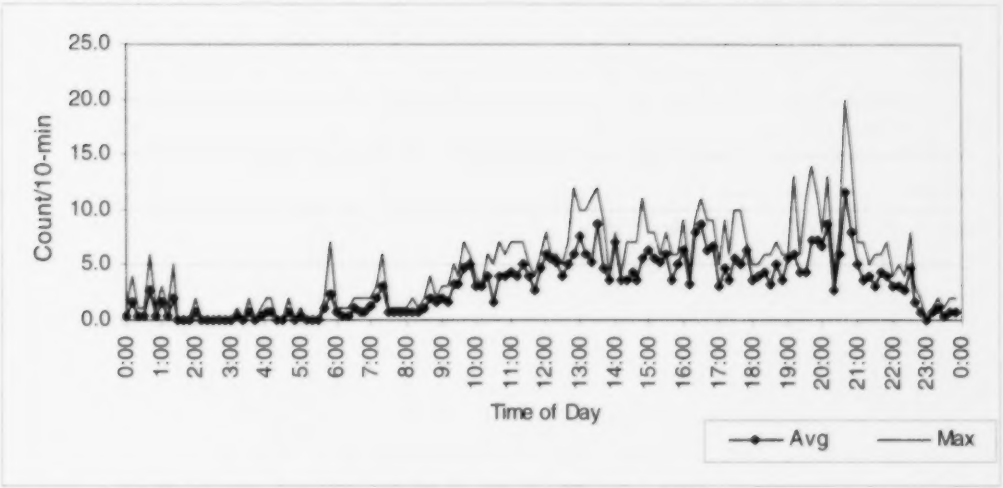


Figure 17 Southbound traffic variation for weekends

6.3 Train Warning Time Characteristics

The trains at RR-232 averaged 21 trains/day. Other than being more frequent during the daytime, the trains do not adhere to a specific schedule. While the automobile traffic was segmented into 10-minute time periods, the railway data has been segmented into hourly intervals. Figure 18 illustrates the time-of-day distribution of train arrivals and crossing violations for 12 March – 6 May and 1 June – 19 June 2004.

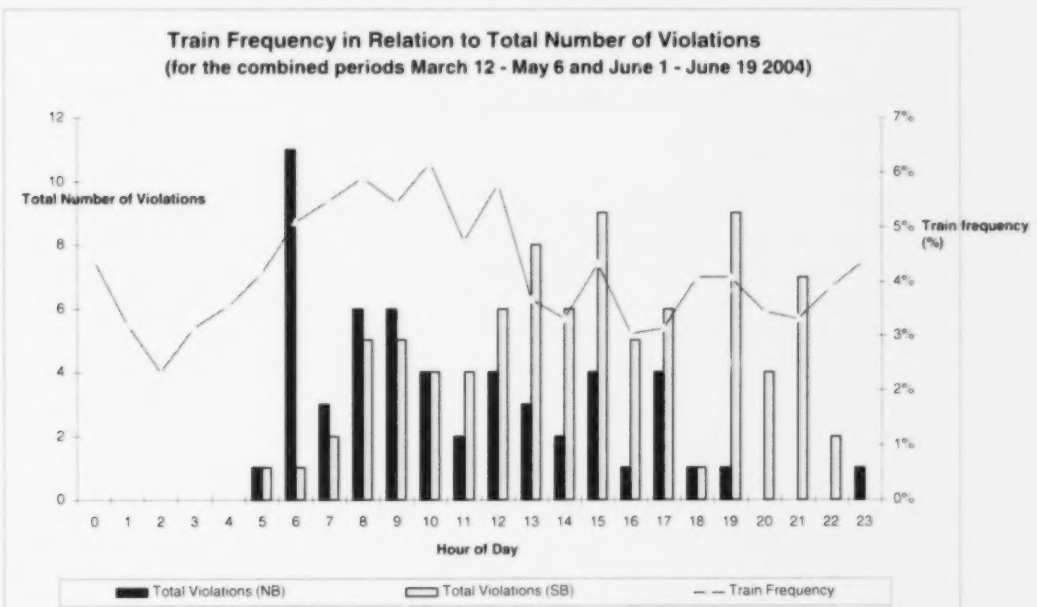

Train Frequency in Relation to Total Number of Violations
(for the combined periods March 12 - May 6 and June 1 - June 19 2004)
Total Number of Violations
Train frequency (%)
Hour of Day
Total Violations (NB)
Total Violations (SB)
Train Frequency

Figure 18 Train and violation time-of-day distributions

The southbound violations are more uniformly spread over the afternoon, while the northbound violations are focused on 6:00 to 7:00 (actually most occur between 6:45 and 7:00 and 8:00 to 10:00).

Figure 19 illustrates the distribution of warning time duration at RR-232 during the month of June, for situations when a train arrives at the road. The bars indicate the number of occurrences of warning times in each 10-second interval up to 200 seconds, and the average warning time of all occurrences above 200 seconds. Thus, the most frequent warning time was between 50 and 59 seconds, with 155 occurrences. There were about the same number of occurrences of warning times in excess of 200 seconds as there were warning times between 20 and 29 seconds (about 18 occurrences). The average warning time for the 18 trains that had warning times greater then 200 seconds was 611, as indicated on the horizontal axis. The cumulative profile is shown with the right side axis and illustrates that 10 percent of the warning times are greater than 100 seconds, and 10 percent are less than 40 seconds. Nuisance alarms (when the train does not arrive) are excluded from the data and from the analysis of driver response.

The data for warning activation that did not result in a train arrival are not included in Figure 18 because these events usually involve stopped switching trains or non-existent trains that do not involve a violation when drivers proceed after stopping. They can, however, contribute to drivers' perceptions of warning credibility/reliability. Over a four month sample period, the number of times the warning lights were activated without a train arriving averaged 0.85 times per day with an average duration of 133 seconds. Many lasted less than 10 seconds, and one lasted 1,400 seconds.

Even though the frequency of nuisance alarms is less than one/day and 90 percent of trains have warning times less than 100 seconds, a driver's perception is based on the frequency of observing different warning times rather than the frequency of occurrence. This is most easily illustrated by comparing the two extreme 10 percentile tails of the distribution in Figure 19. The 10 percent of occurrences of warning times less than 40 seconds produced a cumulative warning time exposure of 33 minutes for the month of June. For the traffic volumes at RR-232, we estimated (see Table 3 in Section 7.2 for more details) that about 4.6 percent of the drivers experienced these warning events. In comparison, the 10 percent of occurrences above 100 seconds produced a cumulative warning time exposure of 265 minutes for the month of June. We estimated that about 44 percent of the drivers experienced these warning events, or about 10 times as many as were exposed to the lowest 10 percent of occurrences. Thus, driver perception of credibility and reliability of warning times is much worse than the frequency of occurrence conveys.

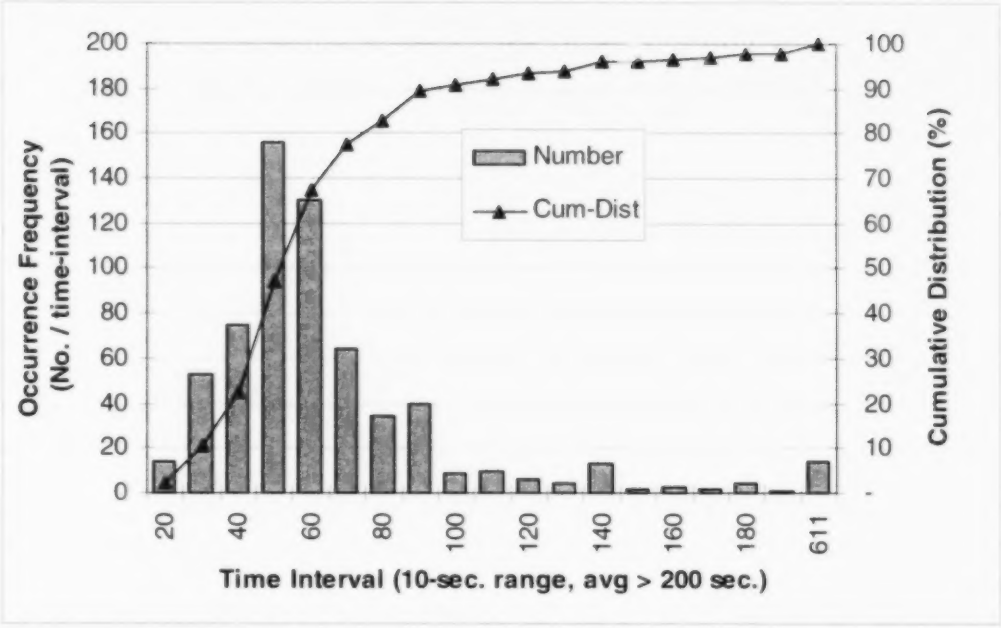


Figure 19 Arriving train warning time distribution for June 2004

7 PERFORMANCE ASSESSMENT

7.1 Safety Impact Quantification

7.1.1 Increased Highway Inter-vehicle Incidents

The safety impact of automated photo enforcement was estimated by a before and after comparison of the frequency and severity of hazardous grade crossing incidents. Only vehicle train incidents were analyzed. However, highway inter-vehicle incidents were also observed and warrant some discussion.

We previously discussed the dilemma zone and made recommendations in Chapter 5. There were also several unsafe acts and other signs of confusion among drivers during the initial period of hardware installation. These included passing stopped cars at the crossing, sudden braking, and swerving to avoid highway loop detectors, all of which involve incremental risk. However, no actual collisions occurred and the frequency of this type of risky behaviour (as related to driver confusion and inter-vehicle incidents) dropped off markedly within a few weeks of installation. There continued to be intermittent cases of drivers displaying different levels of understanding of the laws and different risk profiles when faced with a flashing light and either a stopped or slow moving train. We did not judge these as being as high a risk as the (virtually chaotic) response when the system was first installed. The original chaotic behaviour also did not recur later when the warning notices were activated. With the relatively low traffic levels at RR-232 we did not incorporate inter-vehicle risks into a hazard index. Nonetheless, the problems could have been more acute at a busier grade crossing and the observations accentuate the importance of having laws that place reasonable expectations on drivers and having awareness campaigns that detail the constraints and allowances of the laws before automated photo enforcement hardware is installed.

The types of ongoing risky driver behaviour that were exacerbated by the presence of the automated photo enforcement system and did not involve trains, included drivers bypassing stopped vehicle queues and drivers swerving to avoid the detection loops in the highway. Both of these activities could be mitigated by using loops on both lanes of the highway for enforcement (rather than only on the entrance lanes as was done at RR-232). We recommend that loops be placed on both lanes of the highway in future applications of the technology at non-gated FLB crossings. However, we reiterate that a more rigorous enforcement of the strict wording of laws should only be applied where the laws being enforced place reasonable demands on drivers.

7.1.2 Hazard Scale

On the vehicle-train side, the degree of hazard must consider the two types of unsafe incidents that can occur at a crossing – failure to stop and failure to proceed safely. The first criterion requires a definition of what is accepted as a stop. The present definition in the automated photo enforcement set-up is that any vehicle passing over the loops at a speed of 22 km/h or less is an acceptable stop. While we would quantify a full stop as safer than a rolling stop, the data did not provide an easy way to differentiate the two. Another aspect of the failure to stop violation is the elapsed time from initiation of the warning system. The dilemma period (the

initial 4.5 seconds when drivers cannot safely make a stop) has been excluded from the auto enforcement defined violations.

The violation of not proceeding safely has an even broader range for interpretation. For the high end of the hazard scale, we selected a clearance time of 10 seconds, which is greater than the observed gap-acceptance behaviour of motorists in making left turns across approaching traffic. Li et al. found a mean gap acceptance time ranging from 7.5 seconds for heavy vehicles to 5.5 seconds for light vehicles when making left turns and crossing two lanes of high-density mixed traffic [Li et al., 2003]. Yi observed similar times for gap acceptance at two-way-stop controlled intersections [Yi, 1996]. Mean gap acceptance time was 7.36 seconds for elderly drivers and 5.19 seconds for younger drivers. We found no data on gap acceptance at sites with flashing red lights. The added caution denoted by the flashing red, and the inability of a train to slow or swerve to avoid collision is reflected in our escalation of normal gap acceptance (which reflects driver's risk acceptance) to a higher value that we interpret as a hazardous crossing.

The longer the clearance time (between vehicle exit and train arrival) for a driver proceeding after stopping, the lower the risk involved. We initially considered a interval of 60 seconds as a range of increasing hazard for not stopping, but have adopted Transport Canada's recommendations for railway crossing protection systems (draft standard RTD 10)[6] as the basis for a hazard scale. Since automated photo enforcement of non-gated crossings is a candidate replacement for engineering enhancements to crossings that do not conform to RTD10, it seems appropriate to select the non-hazard end of the scale to the recommended maximum allowable warning times in RTD 10. RTD 10 recommends that the maximum warning time (prior to train arrival) at non-gated FLB crossings not exceed 35 seconds.

We equate the hazard of stopping and then proceeding with a clearance time of less than 10 seconds to the hazard level of not slowing below 22 km/h while the warning system is active. Thus, we scale the level of hazard:

- from a high of 1, for clearance times less-than-or-equal-to 10 seconds (a number larger than existing gap acceptance times for left turns on highways)
- to a low of zero for clearance times greater-than-or-equal-to 40 seconds (a low hazard is set at the 35 second maximum permitted warning time recommended in RTD10).

Figure 20 illustrates the linear hazard scale of proceeding with clearance times less than 40 seconds. A clearance time of ten seconds or less is equal in severity to the act of not stopping (defined as not slowing to 22 km/h).

7.1.3 Estimating Frequency of Occurrence

We used the time-of-day characterizations (see section 6.2) to estimate the number of vehicles that would arrive when the crossing warning system was activated by an approaching train. We then compared this number of expected vehicles with the number of violations that were recorded to get an estimate of the proportion of drivers who were not stopping while the lights were flashing. Drivers not stopping for nuisance alarms and after the train had passed were

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[6] The draft standard RTD-10 is available online at http://www.tc.gc.ca/railway/RSCC/StdErv12.pdf

excluded from the analysis. The resulting violation rate is one measure of the impact of changes at the crossing on driver behaviour.

The second measure of unsafe driver behaviour is the level of risk taking by drivers who stop and proceed. As the auto enforcement system does not record these incidents, we used a one-month sample of videotaped information to estimate the ratio of drivers who stop and proceed through the flashing light to those who do not stop at all. This ratio was different for different clearance times (i.e. the time interval between the vehicle clearing the tracks and the train arriving at the road).

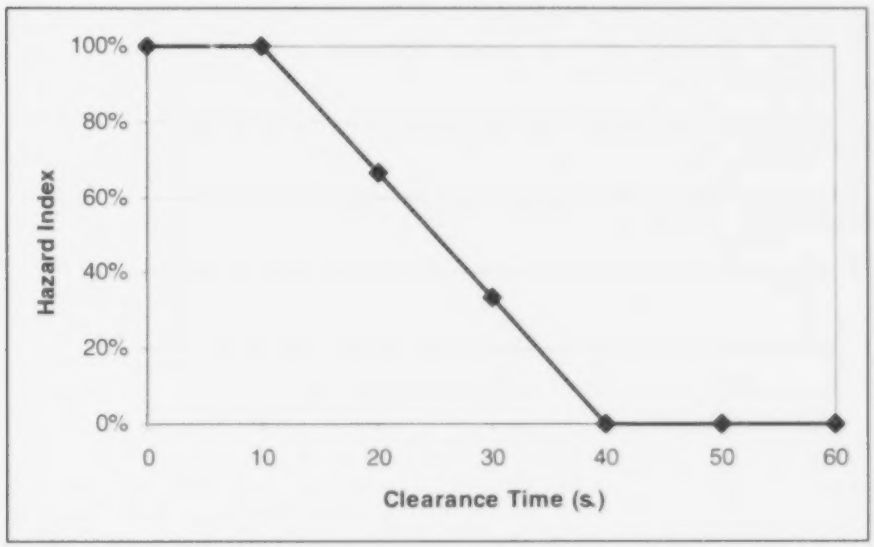

Figure 20 Hazard function assumed for clearance times

7.2 Impact of Advisory Signs on Driver Behaviour

We estimated the impact of advisory signs on driver behaviour by comparing the frequency of occurrences of "unsafe" driver behaviour as defined in Section 7.1. The unsafe behaviour was quantified for one-month samples taken before and after the installation of the legal advisory signs (see Figure 4), which were installed at RR-232 on August 10, 2004. The 'before' month selected was June 2004 and the 'after' month was September 2004.

Table 3 summarizes the assessment of driver violation rates by warning time duration for the month of June. Column 1 presents the intervals of warning time duration by which the data were aggregated. Ten-second intervals are used up to 90 seconds and all occurrences greater than 90 seconds are combined. The second column shows the number of occurrences for that time interval over the month. Thus, there were 11 trains that provided a warning time of less than 30 seconds over the month and 101 that provided warning times greater than 90 seconds. The third column presents the number of vehicles that would have been expected to arrive during those warning intervals. This was derived on the basis of the time of day and day of week that the train arrived and the corresponding traffic density. The fourth column provides

the actual number of non-stopping violations that were recorded and the fifth column indicates the ratio of non-stopping violations to expected arrivals.

The proportion of drivers not stopping is seen to increase with increasing warning time up to 90 seconds, but falls off after 90 seconds. The increase is consistent with the findings of previous research into driver behaviour at railway crossings. The reduction after 90 seconds was unexpected. Review of the videotapes indicates that the longer time intervals sometimes involve trains that stop short of the crossing so as not to block it and wait there for an advance signal. When the train is stopped close to the crossing most drivers stopped prior to proceeding. Also, the longer time intervals give opportunity for clusters of vehicles to arrive. If any one driver stopped or slowed, all following drivers were also forced to slow down or drive around the stopped vehicle and thereby avoid the violation detection loops.

Table 3 Violations by warning time duration (month of June)

Warning Duration	Number of Trains	Expected Vehicles	Non-stopping Violations	Proportion Not Stopping	Stop&Go Violations (est.)	Proportion All Violations
<30	11	7	0	0.0%	0	0%
30 - 40	49	37	2	5.5%	4	16%
40 - 50	69	56	2	3.6%	4	11%
50 - 60	138	158	13	8.2%	26	25%
60 - 70	117	130	15	11.5%	30	35%
70 - 80	61	104	13	12.6%	26	38%
80 - 90	32	49	9	18.6%	18	56%
> 90	101	419	24	5.7%	108	32%
Total / Avg	578	958	78	8.1%	216	31%

The last two columns of Table 3 show the total number of drivers estimated to cross through the flashing red lights and the corresponding ratio. In total, 216 drivers (or 31 percent) were estimated to have gone through the flashing red lights after stopping, while the proportion of drivers who went through without stopping was 8.1 percent.

An attempt was made to infer a 'before' state by collecting highway counter data at a nearby FLB crossing (17th Street in Strathcona County). However, the data did not permit differentiation between a train occupying the crossing and trains approaching the crossing, so a 'before' state could not be assessed from the data. Nonetheless, the data collected at 17th Street indicated that the FLB warning system has very little impact on drivers. Drivers did slow down when it was activated, but very few stopped. The average speed through the crossing was 57 km/h when the FLB was activated, compared with 69 km/h when it was not activated. The violation rate appears to be much lower at RR-232 than at 17th Street, which might indicate that the mere presence of the enforcement equipment at RR-232 had some influence on drivers. On the other hand, the characteristics of the 17th Street crossing are more conducive to violations—it had far more nuisance alarms, slower speed trains and much higher traffic levels. It is not possible to gauge how many of the violations at 17th Street represented unsafe acts.

The other component of the base case representation of RR-232 drivers is the level of risk involved in drivers that proceeded through the crossings. This was measured by the clearance

time between driver exit and train arrival. The data indicate that even though the warning times are long, many of the drivers pass through with short clearance times. The clearance times for the non-stopping violations and estimated stop-and-go violations is shown in Table 4. One can see that 36 percent of the total violations occurred with clearance times of less than 40 seconds.

Table 4 Clearance times for non-stopping violators (June)

Clearance Time (sec.)	Non-stopping Violations	Stop&Go Violations (est.)	Proportion All Violations	Cumulative Distribution
<10	0	0	0%	0%
10 – 20	8	16	9%	9%
20 – 30	12	24	13%	22%
30 – 40	13	26	14%	36%
40 – 50	14	28	15%	51%
50 – 60	6	12	7%	58%
60 – 70	4	8	4%	62%
70 – 80	2	4	2%	64%
80 – 90	2	4	2%	66%
> 90	17	77	34%	100%
Total / Avg	78	198	100%	

The same measures were generated for the month of September, after awareness signs were posted. Table 5 presents the proportion of non-stopping violations and Table 6 presents the distribution of clearance times involved.

Table 5 Violations by warning time duration (month of September)

Warning Duration	Number of Trains	Expected Vehicles	Non-stopping Violations	Proportion Not Stopping	Stop&Go Violations (est.)	Proportion All Violations
<30	6	2	0	0.0%	0	0%
30 – 40	44	30	0	0.0%	0	0%
40 – 50	57	44	5	11.3%	10	34%
50 – 60	131	145	9	6.2%	18	19%
60 – 70	97	110	11	10.0%	22	30%
70 – 80	41	61	1	1.6%	2	5%
80 – 90	22	38	1	2.6%	2	8%
> 90	73	294	30	10.2%	135	56%
Total / Avg	471	726	57	7.9%	189	34%

One can see that the overall rate of non-stopping violations has not changed (8.1 percent before and 7.9 percent after). Also, as seen by comparing Table 4 and Table 6, the level of risk taking is similar: 36 percent before versus 32 percent after, involving clearance times of less than 40 seconds.

Table 6 Clearance times for non-stopping violators (September)

Clearance Time (sec.)	Non-stopping Violations	Stop&Go Violations (est.)	Proportion All Violations	Cumulative Distribution
<10	1	2	1%	1%
10 – 20	5	10	7%	8%
20 – 30	10	20	14%	22%
30 – 40	7	14	10%	32%
40 – 50	7	14	10%	42%
50 – 60	2	4	3%	45%
60 – 70	4	8	6%	51%
70 – 80	3	6	4%	55%
80 – 90	1	2	1%	56%
> 90	17	77	44%	100%
Total / Avg	57	156	100%	

The violation data was aggregated for both directions for the above tables. Table 7 provides a breakout of the violations count by direction and illustrates an interesting phenomenon. The data has always shown a higher incidence of violations for the southbound direction than for the northbound direction. This was unexpected since the northbound vehicles are mostly going to work and the southbound mostly returning home from work. There appears to be a higher value placed on leisure time than on work time. The data indicate that the placement of the signs might have had a greater impact on drivers going to work (going from 6 percent before to 3 percent after), and no impact on drivers leaving work (10 percent before and 11 percent after).

Table 7 Reduction in non-stopping violations

Description	June (before signs)			September (after signs)		
	SB	NB	ratio SB/NB	SB	NB	ratio SB/NB
Opportunities	497	468	1.06	391	360	1.09
Violations	48	30	1.6	45	12	3.75
% violating	10%	6%		11%	3%	

7.3 Impact of Violation Notices on Driver Behaviour

The effectiveness of the warning notices was assessed in the same manner as the awareness signs. Warning notices were initiated on November 1, 2004. The assessment of their impact was made for the 19 day interval of 13 January 2005 to 1 February 2005. The selection of this time interval was largely influenced by data availability, but also provides a reasonable length of time after initiation of warning notices for them to have been received and discussed by employees in the area.

The portion of drivers committing a violation in this interval is summarized in Table 8. One can see that 3.8 percent of drivers did not stop for the flashing red lights. Thus, the impact of the warnings was a 52.5 percent reduction in non-stopping violations from the average of 8 percent for the prior interval (from Table 3 and Table 5).

Stop-and-go violations were not enforced with the equipment, but this fact was not released in the awareness program. The awareness program stated the wording of the law (see section 5.3).

There was an impact on stop-and-go violations. In total, 10 percent of drivers either did not stop or proceeded through the flashing red lights after stopping, but while the train was approaching. The average for the prior interval (from Table 3 and Table 5) was 32 percent. Thus, the impact of the warnings was a 69 percent reduction in combined violations.

Table 8 Violations by warning time duration (January 13-Feb 1, 2005)

Warning Duration	Number of Trains	Expected Vehicles	Non-stopping Violations	Proportion Not Stopping	Stop & Go Violations	Proportion All Violations
<30	2	1	0	0.0%	0	0%
30 - 40	45	21	0	0.0%	1	5%
40 - 50	47	26	1	3.8%	2	12%
50 - 60	129	107	5	4.7%	4	8%
60 - 70	102	101	5	5.0%	7	12%
70 - 80	52	59	3	5.1%	2	8%
80 - 90	21	45	0	0.0%	5	11%
> 90	75	217	8	3.7%	16	11%
Total / Avg	473	577	22	3.8%	37	10%

The previous state of the crossing was characterized by visible but non-operational automated photo enforcement equipment. There is some indication that the presence of the equipment also produced a reduction. The initial violation rate during the first week of equipment installation was more than double the long-term average violation rate during which the equipment was visible but non-operational.

The evolution of violation rates is summarized in Table 9. The detected defined violations column represents those vehicles that met the conditions established as enforceable and were reliably detected by the installed equipment. The last column is the total number of defined enforceable violations, including those that were not detected with the level of reliability required by the measurement system. The latter data were not measured in the earlier stages of the study.

There are other observations of driver behaviour at similar crossings that support the premise that the prior base case situation was worse than the RR-232 measurement period when enforcement equipment was visible. Highway counter data from a nearby crossing in Strathcona County provided vehicle speeds at the crossing exits while the flashing lights were activated. The data indicated that, while drivers slowed down for flashing lights, a very small proportion stopped and waited.

Table 9 Defined violations by period

Date (mm/dd/yyyy)		Interval	Average Number of Detected Defined Violations	Including Non-detected
Start	End	(Days)	(No./Week)	(No./Week)
10/5/2003	10/12/2003	7	39.0	N/A
10/13/2003	11/27/2003	45	21.8	N/A
11/28/2003	1/15/2004	47	15.8	N/A
1/15/2004	2/11/2004	26	17.2	N/A
2/11/2004	3/10/2004	29	16.2	N/A
3/16/2004	4/26/2004	40	13.8	20.5
4/26/2004	10/3/2004	157	17	22.3
11/01/2004 Warning Citations Begin				
11/01/2004	01/04/2005	63	7.0	9.6

A study by Richards et al. included a non-gated FLB crossing with a 5 mph to 40 mph range of train approach speeds, which is very similar to the range at RR-232 [Richards et al., 1991]. The breakout of drivers' responses was:

- Non-stops 19 percent
- Stop and go 61 percent
- Stop and wait 20 percent

If the real base case situation involved a violation rate that was twice the measured rate with visible equipment, the reduction rate with warning notices would be about 75 percent rather than 53 percent. This is consistent with observations made on the Los Angeles MBL (discussed in section 3.2).

The apparent ineffectiveness of the posted awareness signs was reinforced by the observations in the warning-citation phase. There is some indication that the law was not understood even though signs that summarized the Alberta wording of the law were placed at the crossing. Many drivers stopped and waited at the activated FLB even while the train was stopped. The clearly visible signs (which indicated they could proceed after stopping if the train stopped) were not enough to get people to cross. There were a number of instances when train engineers on stopped trains would turn off the locomotive lights in an attempt to persuade the queue of drivers to proceed, but had no affect. Some drivers balked the queue and turned around rather than wait and/or bypass the queue.

7.4 Cost Effectiveness

The main influence of the effectiveness of automated photo enforcement of railway crossings in comparison with highway intersections is the exposure time to red lights. At highway intersections, red light cameras are monitoring two and sometimes four approach quadrants, which have a red light active at least 50 percent of the time. For the railway crossing, there are only two approach directions for drivers and the exposure to a red light is only a small fraction of that of a highway intersection. In addition, there are many more transition periods (when a light changes from green/yellow to red) at highway intersections than at railway crossings.

Table 10 compares the exposure time and transition frequency for a typical highway intersection with RR-232. One can see that the exposure level (i.e. opportunity to violate) is significantly higher for the highway intersection with a daily red duration of 720 minutes versus 28 minutes at RR-232. With the added impact of higher traffic volumes, the end comparison of vehicles opportunities is 10,000 at the highway intersection compared with 41 at RR-232.

Table 10 Potential violation exposure indicators

Characteristic	Typical Highway	RR-232 (status quo)
Duration of FLB warning prior to train arrival (min. per day)	> 720	28
Activation frequency (#/day)	> 500	21
Vehicle arrivals during red activation (#/day)	10,000	41

On the other hand, non-gated FLB railway crossings can have higher violation rates – some crossings such as RR-232 that have nuisance alarms and long warning times exhibit even higher violation rates – and the consequences of a grade crossing collision can be much more severe than a highway intersection collision.

7.4.1 Effectiveness

The impact of automated photo enforcement discussed in section 7.3 related to its impact on driver behaviour and the number of violations. In this section we interpret the changes in behaviour with respect to the level of risk involved. The methodology used was discussed in section 7.1 and involves increasing risk with shorter clearance times (train arrival – vehicle departure). The base methodology assumes that any non-stopping vehicle warrants the highest level of risk, the same as allocated to a stopping driver who proceeds with less than 10 seconds of clearance time. While a stopping driver is allocated zero risk if he/she proceeds with more than 40 seconds clearance time, a non-stopping driver with extended clearance times is still allocated the maximum risk score.

The clearance times associated with the non-stopping and stop-and-go violations during the 19-day evaluation period are summarized in Table 11.

The hazard index associated with the before and after states is summarized in Table 12.

The two before states each involved the visible presence of non-operational automated photo enforcement equipment. As discussed, there was some evidence that the presence of the equipment led to a reduction of violations.

7.4.2 Cost Quantification

The equipment costs involve the following components:

- capital and installation cost,
- service life of equipment,
- annual maintenance costs.

Table 11 Clearance times for all violations (January 2005)

Clearance Time (sec.)	Non-stopping Violations	Stop & Go Violations	Proportion All Violations	Cumulative Distribution
<10	1	0	2%	2%
10 – 20	1	4	8%	10%
20 – 30	4	5	15%	25%
30 – 40	0	5	8%	34%
40 – 50	4	7	19%	53%
50 – 60	4	3	12%	64%
60 – 70	1	6	12%	76%
70 – 80	3	4	12%	88%
80 – 90	1	0	2%	90%
> 90	3	3	10%	100%
Total / Avg	22	37		

Table 12 Hazard index comparison

Factor	Hazard Index (per 100 trains)		
	Pre -1	Pre -2	Warning Citations
Non-Stop	13.5	12.1	5.4
Stop & Go	5.3	4.9	1.6
Total	18.8	17.0	7.0

Pre –1: Visible but non-operational automated photo enforcement equipment
Pre –2: Visible but non-operational automated photo enforcement equipment plus awareness signs

Automated photo enforcement involves additional factors associated with the revenue and costs of ticketing. The following factors need to be considered:

- processing (and interpreting) costs of violations,
- a success rate of violations processed,
- offsetting revenues from successful tickets,
- variations over time as traffic grows and violations rates reduce.

The other key cost component to be included in a transportation investment is the value of time for any change in waiting delays. Since the installation is located in an industrial area, the local average industrial wage was used for the value of time.

We did not allocate a value of life for potential fatality reductions due to reduced violations. The collision rate is not high enough to accurately determine a meaningful number. Rather, the benefit was determined by the hazard index as discussed in section 7.1.

The automated photo enforcement system involves annual operating and maintenance costs, and offsetting revenues from the ticketed violations. We have used the costs shown in Table 1 as monitored by the state of Illinois in its application of a similar system. We assume that automated photo enforcement equipment would be an initiative of the road authority, and thus

not subject to the overheads assigned for track-side upgrades. We have used the installed cost reported for Illinois's automated photo enforcement system of CA$140,000.

While the estimated annual operating cost in Illinois was US$2,000/month, we believe that the marginal costs of adding one relatively low violation-rate grade crossing in Strathcona County where a highway based automated photo enforcement system is in place would be much lower. Our estimate is CA$625/month, about 25 percent of Illinois costs on a monthly basis, but about 133 percent on a per-citation issued basis.

The revenues from tickets are directly related to the volume of traffic on the road and inversely related to its violation reduction effectiveness. RR-232 has a much smaller traffic level than existed at the gated crossings involved in the other studies cited in chapter 3. In addition, not all detected violations lead to tickets. All automated photo enforcement systems have a portion of violations that do not get processed through to ticketing. The reasons for not issuing citations for the two-month interval of November 2004 and January 2005 are summarized in Table 13. As indicated, 73 percent were photographed (or 27 percent were not initially photographed) because the measurement system does not detect and position the vehicle with the accuracy it demands. Of the ones that were photographed, about half were not usable for various reasons. In total, the proportion of successful citations issued for the defined enforceable non-stopping violations at RR-232 was 37 percent.

Table 13 Detection success rate for November/December

Category	Number	Percent
Total non-stopping violations	86	100%
Successfully measured	63	73%
Less non-usable due to:		
Photo not clear	5	
Plate cover or avoidance	13	
Other	13	
Successfully processed	32	37%

Alberta's fine for grade crossing violations is $230. The weekly revenue from successfully processed violations would be:

Revenue = 8.1 violations/wk x 37% success rate x $230 = $689/wk. ($35,844/yr.)

Under Alberta law drivers must stop and wait if the FLB is active and the train is moving. We noted previously that many drivers would not continue even if the train stopped. In our cost assessment, we assume that drivers would eventually become aware that it is not a violation to proceed after the train has stopped and it is safe to do so, which is the case on the single track line involved at RR-232. However, for those situations where the warning system is active and train arrival is more than 40 seconds away, drivers must stop and wait even though it is a zero hazard event on our hazard scale. For the observed warning time distribution at RR-232 and considering only trains that did arrive at the crossing, the vehicle delays resulting from a rigid conformance to the law are 10.3 hours per week. This delay is a cost to the automated photo enforcement system when it is being compared with technological or operational alternatives.

Based on an average occupancy of 1.1 persons per automobile with a value of time equal to the average industrial wage in the area ($17/hr), and 15 percent truck traffic with a value of time of $50/hr, the annual delay costs are $12,540.

The resulting costs and revenue are summarized in Table 14. The net present value assumes a 25 year life and 10 percent discount rate. As noted, the operating cost of Illinois automated photo enforcement system was 4 times our estimated marginal cost for Strathcona County. Thus, the life cycle costs could be significantly different under different cost allocation assumptions.

Table 14 Estimated costs

Cost Category	Cost (NPV C$)
Installed Capital Cost	$140,000
Incremental Operating Costs	$295,000
Incremental Revenues	($326,000)
Incremental Driver Delay Costs	$114,000
Total Cost	$223,000

As one can see, even with assumptions of lower operating costs, automated photo enforcement at RR-232 would not be self-supporting from ticket revenues. The revenue sharing arrangements that are common in highway applications of automated photo enforcement would not be feasible at RR-232. However, most measures taken to improve safety at grade crossings involve investments. It is possible that automated photo enforcement would be a viable alternative to other grade crossing investments.

The principal alternative investment at non-gated FLB crossings with warning time variability characteristics similar to RR-232 is to reduce the duration and variability of the warning through the use of constant warning time (CWT) activation circuits. However, the relative effectiveness of CWT circuits in reducing risky behaviour is not known in sufficient detail to make a comparison. Considering the data collected, RR-232 would make an ideal test site for an upgrade to CWT to get a consistent set of data for comparison.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Technology

There are two types of potential violations at grade crossings equipped with flashing lights and bells: drivers who do not stop when the warning system is activated, and drivers who stop but proceed when it is unsafe to do so. The present technology can detect vehicles that do not stop, but does not provide a means of automatically detecting the second type of risky behaviour. Proceeding unsafely can be gauged by the time between vehicle departure and train arrival. We believe that this form of risky behaviour should also be detected and enforced when the technology is used at non-gated FLB grade crossings. We recommend that both the regulations and automated photo enforcement technology be modified to facilitate the definition and enforcement of unsafe stop-and-go violations if the technology is to be used at non-gated FLB crossings. The ideal enforcement would involve a sliding scale of fines that decrease with increasing clearance time, similar to the severity scale applied for speeding fines.

Many vehicles are accelerating or decelerating at grade crossings, often as much in response to the bump encountered as from a cautionary move. Consequently, systems that ignore violations by vehicles that are accelerating/decelerating will have a lower enforcement rate. Since a high level of speed measurement accuracy has been found to be unnecessary in obtaining the required evidence, we recommend that, for future installations, road authorities relax the speed accuracy specification for failure to stop violations, and that suppliers in turn relax the present software constraints that exclude accelerating/ decelerating vehicles from detection.

8.2 Implementation

There were also several unsafe acts and other signs of confusion among drivers during the initial period of hardware installation. These included passing stopped cars at the crossing, sudden braking, and swerving to avoid highway loop detectors, all of which involve incremental risk. However, no actual collisions occurred and the frequency of this type of risky behaviour (as related to driver confusion and inter-vehicle incidents) dropped off markedly within a few weeks of installation. While intermittent cases persisted throughout the operational phase, it was far lower in scale than the initial confusion. The severity of these actions did not escalate later when the warning notices were activated. With the relatively low traffic levels at RR-232 we did not incorporate inter-vehicle risks into a hazard index. Nonetheless, the problems could have been more acute at a busier grade crossing and the observations accentuate the importance of having laws that place reasonable expectations on drivers and having awareness campaigns that detail the constraints and allowances of the laws before automated photo enforcement hardware is installed.

The types of risky driver behaviour that were exacerbated by the presence of the automated photo enforcement system and did not involve trains, were drivers bypassing stopped vehicle queues and drivers swerving to avoid the detection loops in the highway. Both of these activities could be mitigated by using loops on both lanes of the highway rather than only on

the entrance lanes as was done at RR-232. We recommend that loops be placed on both lanes of the highway in future applications of the technology at non-gated FLB crossings.

8.3 Legal Framework

Automated photo enforcement can only enforce the existing laws. We believe that traffic laws need to achieve a balance between specifying actions that are recognized as safe, while allowing drivers to make fair and reasonable judgments in response to the wide range of circumstances they can encounter. It is our opinion that laws dealing with complex situations should be kept simple and the details of the range of scenarios that can exist should be left to driver education programs. It is of interest that appropriate driver response to railway crossing signals, while involving a complex set of scenarios requiring driver interpretation and judgment is the smallest (and in many cases non-existent) component of most driver training manuals. We recommend that Transport Canada encourage provinces to highlight the various situations and complexities that exist at railway grade crossings and develop with the provinces a recommended wording for driver training manuals and, where necessary, wording for the underlying regulations. We further recommend that the need for harmonization of these regulations be brought to the attention of the appropriate committee of the Canadian Council of Motor Transport Administrators (CCMTA). We recommend that the CCMTA pursue changes to, and harmonization of, the content of provincial driver's handbooks and protocols followed in driver testing as they relate to railway crossings.

We recommend that the CCMTA evaluate the merits of adopting the simplified wording used at flashing light highway intersections (i.e. one must stop and shall not proceed until it is safe to do so). We recommend that the wording include a second distance constraint—in addition to the specifying *stopping no closer than 5 m from the nearest track*, it should specify a *maximum of no more than 15 m*. This would prevent moving queues of vehicles and allow the detection system's speed threshold to be set much lower, thereby providing a more uniform and fair enforcement of non-stopping violations.

The impact of the dilemma posed at the onset of warnings at grade crossings (too close to safely stop when the FLB is first activated) could affect the overall safety impact of automated photo enforcement. The introduction of a penalty for a situation that already poses a dilemma to the driver could exacerbate the existing problems of unpredictable speed variation in approaches to grade crossings. If automated photo enforcement is pursued further at grade crossings, we recommend that drivers in the dilemma zone be allowed to pass through without incurring a fine, and to advertise the fact in awareness campaigns to minimize driver confusion and the chances of rear-end collisions. This could be handled by using the same wording as exists for amber stage traffic lights (i.e. drivers must stop if it is safe do so). Where this or similar wording does not exist, we recommend that a suitable grace period be provided in the implementation of automated photo enforcement systems and its existence advertised in awareness campaigns.

8.4 Effectiveness

The impact of the warning citations was a 53 percent reduction in non-stopping violations from the averages of 8 percent for the prior interval to 4 percent after. Stop-and-go violations were not enforced with the equipment, but this fact was not released in the awareness

program. In total, 10 percent of drivers either did not stop or proceeded through the flashing red lights after stopping, but while the train was approaching. The average for the prior interval was 32 percent. Thus the impact of the warnings was a 69 percent reduction in combined violations. In terms of the hazard scale adopted for the evaluation, a reduction of 61 percent was realized.

The previous state of the crossing was characterized by visible but non-operational automated photo enforcement equipment. There is some indication that the presence of the equipment also produced a reduction in violations. The initial violation rate during the first week of equipment installation was more than double the long-term average violation rate during which the equipment was visible but non-operational.

We conclude that automated photo enforcement did reduce risky driver behaviour at the non-gated FLB crossing.

8.5 Additional Testing at Non-gated FLB Sites

Since the exposure levels (vehicles arriving during an active red warning) are much lower at non-gated FLB grade crossings than at highway intersections and at gated grade crossings, it is unlikely that automated photo enforcement could realize full cost recovery from ticket revenues (as it does in many highway installations). Its cost effectiveness in comparison with other technological investments made at grade crossings needs to be assessed. Considering the data collected, RR-232 would make an ideal test site for an upgrade to constant warning time operation to get a consistent set of data for comparison.

The technology warrants further evaluation at non-gated FLB grade crossings with identified problems of driver behaviour. We believe that a more rigorous enforcement of the strict wording of laws should only be applied where the laws being enforced place reasonable demands on drivers. We recommend that longer-term tests be conducted at a non-gated FLB crossing in a jurisdiction that provides for ticketing and allows drivers to proceed when it is safe to do so. The technology deployed should allow identification (and ideally enforcement) of high-risk stop-and-go violations.

While the technology is focused on risk takers, there is a possibility that the presence of the system could lead to an increased awareness of the presence of a grade crossing and fewer incidents of *distracted driver* collisions. The long-term effectiveness of automated photo enforcement in modifying risky behaviour and its influence in alerting drivers to the presence of a grade crossing should be the focus of future tests.

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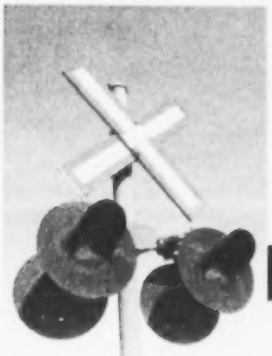
APPENDIX A

MEDIA RELEASE



news release

October 22, 2004

Pilot project tests use of camera enforcement at railway crossing

A railway crossing in Strathcona County is the location of a pilot project that will help determine whether automated enforcement cameras have the potential to improve safety at railway crossings.

The project is taking place at the CN crossing north of Highway 16 near Sherwood Park on Range Road 232, used by more than 1,200 vehicles and over 20 trains daily.

Starting Monday, November 1, motorists will receive warning notices in the mail if they drive across the tracks without stopping when the lights are flashing. The intent of the notices is to make drivers aware of the legal and safe procedures at railway crossings when warning lights and bells are activated.

In Alberta between 1998 and 2002, 25 people were killed and 179 injured in collisions between trains and vehicles. Provincial legislation in Alberta requires that drivers stop their vehicles no closer than five metres from the closest rail when the lights are flashing, and not proceed until the train has passed by or stopped, and the vehicle can safely cross.

Cameras were installed at the crossing in October 2003 to monitor traffic. Since then, an average of 113 violations have been recorded each month—that is, vehicles that fail to stop when the lights are flashing. The cameras used in the pilot project are the same as those used to record red light violations at road intersections.

Alberta's existing legislation does not permit the use of automated enforcement at railway crossings, so warning notices and not tickets are being issued.

...continued

This pilot project is part of a research initiative established in 1999 under Direction 2006, a partnership between railway companies, public safety organizations, police unions, community groups, Transport Canada and other levels of government. The project has been made possible with the collaboration of partners who share an interest in reducing the number of train-vehicle collisions—Alberta Transportation, Strathcona County, the RCMP and Transport Canada's Transportation Development Centre.

"RCMP Traffic Services is dedicated to improving public safety on our roadways," says Corporal Ben Wilkowski of the Strathcona County RCMP detachment. "The average driver rates himself or herself as very good, but some only follow the rules of the road when police are right there and when those rules don't conflict with their immediate needs. They become excellent drivers when they see a police car, they slow down briefly for photo radar, and compliance has increased significantly at intersections where red light cameras are installed. If automated technology can enhance compliance and improve driver behaviour at railway crossings, road user safety should also improve. Any efforts to save lives and reduce injuries are welcomed by the police."

"Strathcona County is pleased to participate in projects that can lead to improved safety for our residents," says Mayor Vern Hartwell. Strathcona County was one of the first municipalities in Canada to adopt red light cameras at major road intersections.

Research in the United States has shown that technological enforcement has been effective in reducing violations at railway crossings. The project in Strathcona County will help to determine whether a similar improvement can be achieved across Canada. It will also provide information on what conditions around railway crossings may make the use of technology applicable and cost-effective.

Contact:

RCMP	Corporal Ben Wilkowski, (780) 449-0129
Strathcona County	Mayor Vern Hartwell, (780) 464-8000 (Mayor Hartwell is in office until October 26, 2004)
Transport Canada	Marie-Josée Dubois, (613) 993-0055

APPENDIX B

QUESTION AND ANSWER SHEET

1. Why is automated enforcement technology being evaluated in a pilot project at a highway-railway grade crossing?

The Transportation Development Centre of Transport Canada and Alberta Transportation in partnership have developed this pilot project to investigate, demonstrate and evaluate the effectiveness of automated enforcement technology in improving railway grade crossing safety. In collaboration with various other key stakeholders such as Strathcona County, the Strathcona County RCMP, Canadian National Railway (CN), Canadian Pacific Railway (CPR), Affiliated Computer Services (ACS) and others, the test component of this project was implemented at a railway grade crossing in Strathcona County, Alberta.

Strathcona County is one of a number of jurisdictions in Canada where automated enforcement technology is currently deployed. The technology is used specifically as a red-light camera at road intersections. Research in the U.S. has clearly shown that this technology is also effective in reducing risky behaviour and violations at railway grade crossings. This project has been established to determine whether similar improvements can be obtained at railway grade crossings within a Canadian context. The outcome of this project is also expected to provide valuable knowledge on what conditions, unique to grade crossings, are required to make this technology applicable and cost-effective. The pilot project analysis will likely also shed much light on the impact of this technology on motorists' behaviour at grade crossings.

2. At which railway grade crossing in Strathcona County is the technology being pilot tested?

Cameras have been installed northbound and southbound at the Canadian National Railway (CN) crossing tracks on Range Road 232 north of Highway 16.

3. How do you determine the railway grade crossing at which the technology will be pilot tested?

The automated enforcement technology is deployed at the above-mentioned grade crossing because it ranked favorably against a set of criteria that was established by the project implementation committee, which consists of representatives from the key stakeholder organizations. The two principal criteria were a high rate of violations and a warning system that excludes gates.

At the Strathcona County pilot project location, between October 1, 2003, and February 29, 2004, the cameras recorded 568 violations at the tracks — that is, drivers who crossed the tracks while the lights were flashing without having stopped. This translates to an average of 113 violations per month. The number of violations includes both directions, northbound and southbound.

4. How does the automated enforcement technology work?

Activation of the automated enforcement technology occurs only when a vehicle fails to stop at the grade crossing after the flashing lights and ringing bells have been activated. The system is dormant at all other times.

The technology is composed of five major elements: detection loops, camera, central processing unit (CPU), camera housing and auxiliary flash.

The system activates in conjunction with the rail crossing signals. During a violation, the camera captures two photographs. The first photograph is taken only if the lights and bells are active and a vehicle crosses the detection loops without stopping. Using a time-distance calculation, the CPU calculates the time interval for the car to travel through the crossing. The camera snaps the second photograph when the car is traveling through the crossing.

Clearly visible in each photograph is the vehicle committing the violation, the license plate and other visible environmental conditions. Each photograph has a superimposed data box that contains the time, date and location of the violation, the speed of the offending vehicle and the number of seconds after the lights started flashing that the vehicle illegally entered the grade crossing.

5. What constitutes a railway grade crossing violation?

Drivers must stop their vehicles no closer than 5 metres to the closest rail when the lights are flashing at a railway grade crossing.

Motorists must not proceed until the train has passed by or stopped and the vehicle can safely cross. Section 42(2) of Alberta's Use of Highways and Rules of the Road Regulation (AR304/2002) under the Traffic Safety Act stipulates that a vehicle must stop no closer than 5 metres back from the nearest rail of the railway when the electronic signal device is giving warning. The person driving the vehicle may not proceed to drive the vehicle across the railway crossing until the train has passed by the crossing or the train has come to a full stop, and the vehicle can be driven in safety across the railway crossing.

6. How many vehicles use Range Road 232 daily?

Traffic counts show that roughly 1,200 vehicles pass through this crossing on a daily basis.

7. How many trains use this track daily?

In excess of 20 trains travel through this grade crossing on a daily basis.

8. What is the average speed of the trains on this track?

Trains traveling through this crossing on a daily basis reach speeds of approximately 70 km/h.

9. What is the speed limit on the roadway where the automated enforcement technology is deployed?

The speed limit on the roadway where the pilot project has been installed is 70 km/h.

10. How many collisions between trains and vehicles have there been in Strathcona County?

In 2002, a vehicle collided with a train in Strathcona County, resulting in a fatality. Also, in 1996 a collision between a train and a vehicle in the County led to serious injuries.

11. In Alberta, how many people have been killed or injured in collisions between trains and vehicles?

Between 1998 and 2002, 25 Alberta road users were killed and 179 were injured in collisions between trains and vehicles.

12. How many Canadians have been killed or injured in collisions between trains and vehicles?

According to Operation Lifesaver (a national public education program sponsored by the Railway Association of Canada and Transport Canada), in Canada in 2003 there were 248 collisions between trains and vehicles, resulting in 26 fatalities and 51 serious injuries.

13. For how long will the enforcement technology be pilot tested at this particular railway grade crossing in Strathcona County?

The railway grade crossing pilot project will continue operating until December 31, 2004, at which time the results will be assessed by the various stakeholders involved in the program.

14. What about cases where the lights flash for several minutes without a train passing or stopping? Are drivers expected to remain stopped indefinitely?

When the lights are flashing, motorists are required to stop at the grade crossing and remain stopped until the train has passed or stopped and it is safe to proceed. This is without exception.

15. If a train is coming and is very far away, why can't a driver simply continue over the tracks if it is clear and there is enough time to do so?

To protect the public, the law requires motorists to stop at the grade crossing once the signal has been activated. Motorists may only proceed after the train has passed or stopped and when it is safe to proceed. Train speeds are difficult to determine. Flashing lights and bells are

designed to be activated with enough time for motorists to stop or clear the intersection before the train arrives.

16. If a train is approaching and I stop and then proceed, will I get a warning notice?

It is unsafe and illegal to fail to stop or to stop and proceed unless the train has stopped or passed when the lights are flashing. Warning notices will be issued to those motorists who fail to stop at the grade crossing when the lights are activated.

17. Why are you sharing the location of the railway grade crossing technology with the public?

Since the goal of this project is to gauge the effectiveness of automated enforcement technology as a tool for changing driver behaviour, advising the public of the location of the technology is essential to the project's success. Project stakeholders have consequently developed an extensive public awareness campaign in an effort to ensure motorists using the roadway where the technology is deployed are fully aware of the camera's existence.

As part of the public awareness campaign, signs have been installed immediately north and south of the crossing, notifying motorists how the camera works and what constitutes a violation. Our experience with automated enforcement cameras at major intersections has been that by being open and up-front with drivers, most are willing to drive more safely. Other communications materials that are to be issued as part of the public awareness campaign include: a news release, a media card (that will be distributed to businesses in the vicinity of the project site) and an ad campaign in local papers.

18. Why do people get warning notices and not tickets?

Existing legislation in Alberta does not permit the use of automated enforcement technologies at railway grade crossings. At this time, only warning notices can be forwarded to registered owners of vehicles who violate the warning signal at grade crossings in an effort to encourage them to modify their driving behaviour and adopt safe and legal driving practices.

19. If tickets aren't issued, what is the benefit of using the cameras?

Warning notices serve to notify motorists of the dangers of failing to obey a signal at a grade crossing. Raising public awareness of the dangers of failing to obey a signal at a crossing not only serves to improve the safety and well being of the motorists using the grade crossing, but more generally it also improves traffic safety in the community for the benefit of all road users.

20. Are the stakeholders involved in this project in favour of legislation that would allow tickets to be issued to motorists who fail to obey signals at railway crossings as identified by the cameras?

This is a study to test the effectiveness of using technology to improve driver behaviour at railway grade crossings. Project stakeholders are aware that the results of this pilot project may suggest that legislation be changed to allow for the issuing of tickets at railway crossings through the use of automated enforcement technologies.

21. Who would receive the fine revenue from violations that occur at grade crossings?

Should legislation be amended to permit tickets at some future date, most of the money received from violations at railway grade crossings will go into the general revenue fund for Strathcona County. As with other traffic violation tickets, a portion of the revenue (15 percent) will be directed to the Victim Services Fund for Alberta.

It should be emphasized, however, that the real goal of the legislative amendments, should they occur, is improved safety. Since 2001, in Strathcona County the percentage of motorists speeding and running red lights has declined significantly, and so has revenue from red light cameras and photo radar.

22. Why would you deploy technology rather than using police officers to enforce violations at railway grade crossings?

The use of technology to monitor motorists who fail to obey flashing lights at railway grade crossings is an effective use of police resources. Technological enforcement does not replace police officers, but rather supplements regular enforcement.

23. Does railway grade crossing technology violate motorists' privacy?

No. Driving is a regulated activity on public roads. By obtaining a licence, motorists agree to abide by certain rules—to obey traffic signals, for example. Neither the law nor common sense suggests drivers should not be observed on the road or have their violations documented. Moreover, there exists no expectation of privacy for a motorist operating on a public roadway, let alone a motorist who has committed a violation.

Also, the technological enforcement deployed in Alberta photographs only the rear of the vehicle, focusing on the rear licence plate. The vehicle's occupants are not identifiable in these images taken of the violation.

24. Who are the stakeholders involved in this pilot project for the railway grade crossing signal enforcement technology?

The principal stakeholders involved in the development and implementation of this project include: the Transportation Development Centre of Transport Canada, Alberta Transportation,

Strathcona County, the Strathcona County RCMP, Canadian National Railway (CN), Canadian Pacific Railway (CPR) and Affiliated Computer Services (ACS). Other partners participating in this pilot program include: the Alberta Centre for Injury Control and Research (ACICR), the Alberta Traffic Safety Foundation, Operation Lifesaver and Direction 2006.

25. Who is covering the costs of this research project?

The majority of the costs of this research project are being covered by the Transportation Development Centre of Transport Canada and Alberta Transportation. In-kind support mainly in the form of resources – personnel, equipment and materials – is being provided by Strathcona County, the Strathcona County RCMP, ACS, CN and CP.

26. Is enforcement technology used at railway grade crossings in other countries?

Automated enforcement technology is currently used to deter crossing violations in Europe, Asia and the United States. In the United States, this technology is currently being used in two jurisdictions: on the Metro Blue Line in Los Angeles, California, and in Wood Dale, Illinois. Three years ago, the technology was also deployed in a pilot project on the Metrolink Line in California.

As of December 2003, 42 crossings are being monitored on the Metro Blue Line with automated enforcement technology. To date, the deployment of this technology has led to a reduction of approximately 50 percent in violations since it was introduced. Wood Dale, Illinois, currently has four cameras in operation.

27. Does the public support the use of technological enforcement to enforce traffic violations?

Surveys that have been conducted in Alberta in the past consistently show that the majority of Albertans support the use of technological enforcement to enforce traffic violations.

28. Whom do I contact for more information on the railway grade crossing signal enforcement pilot project in Strathcona County?

For further information on this program, please contact: Corporal Ben Wilkowski of the Strathcona County RCMP Detachment, 911 Bison Way, Sherwood Park, Phone: 467-7741.

Prepared by:

The Automated Railway Grade Crossing Signal Enforcement Technology Steering Committee

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